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Empathy, Embodied Simulation, and the Brain: Commentary on Aragno and Zepf/Hartmann

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EMPATHY, EMBODIED SIMULATION, AND THE BRAIN: COMMENTARY ON ARAGNO AND ZEPF/HARTMANN

The notion of empathy, or *Einfühlung,* has seen renewed interest among cognitive neuroscientists over the past decade, especially in light of many neuroscientific discoveries in the domain of social cognition. However, as recently stated by de Vignemont and Singer (2006), "There are probably nearly as many definitions of empathy as people working on the topic" (p. 435).

The problematic nature of empathy and of its functional characteristics is not a prerogative of the neuroscientific debate. Indeed, it also involves psychoanalytic thought, as clearly epitomized by the two papers by Aragno and Zepf and Hartmann that I will briefly comment on. One of the topics of debate in psychoanalysis concerns how to relate the notion of empathy with the concepts of transference and countertransference. Aragno considers empathy an automatic and direct mode of access to the inner world of the other, typical of daily social interactions, that in psychoanalytic practice, however, must be employed deliberately within an interpretive disposition, from a referential dispositional stance, as it were. Zepf and Hartmann, by contrast, focus more on the clinical relevance of empathy and emphasize how empathic understanding is the outcome of psychic processes enabling the deliberate use of countertransference for the purpose of knowing what is in the analysand's mind.

Both articles relate their theoretical and clinical arguments to the results of empirical research in developmental psychology and cognitive neuroscience, though taking radically different attitudes. Zepf and Hartmann quickly dismiss (perhaps *too* quickly) the heuristic value of neuroscience and developmental psychology; according to them, research findings

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from these disciplines cannot shed light on inner psychic processes, whether of children or adults, because of the irreducible gap between behavior and mental life. Aragno, in contrast, adopts a semiotic developmental perspective capitalizing on the results of infant research and discusses empathy and its role in psychoanalytic practice against the background of neuroscientific research. Such divergent attitudes epitomize once more the controversy in psychoanalysis—so nicely summarized in Aragno's article—about empathy and its role in everyday life and clinical practice, on the one hand, and on the other, more generally, about the relative importance of intra- versus interpsychic processes.

In this commentary I will briefly review empirical evidence supporting a "broad" usage of the notion of *Einfühlung* and summarize how this usage is consonant with a particular notion of *Einfühlung* as emerging from the philosophical tradition. I will finally capitalize on the presented empirical evidence to discuss how a neuroscientifically based notion of *Einfühlung* could be relevant to some aspects of psychoanalytic theory.

MIRRORING MECHANISMS IN HUMANS

After the discovery of mirror neurons in the macaque monkey brain (Gallese et al. 1996; Rizzolatti et al. 1996) several studies using different experimental methodologies and techniques have demonstrated also in the human brain the existence of a mechanism directly matching action perception and execution, defined as the mirror neuron system (MNS) (for review, see Rizzolatti et al. 2001; Gallese 2003a,b, 2006; Gallese, Keysers, and Rizzolatti 2004; Rizzolatti and Craighero 2004). During action observation there is a strong activation of premotor and posterior parietal areas, the likely human homologue of the monkey areas in which mirror neurons were originally discovered and described. The mirroring mechanism for actions in humans is somatotopically organized, with distinct cortical regions within the premotor and posterior parietal cortices being activated by the observation/execution of mouth-, hand-, and foot-related acts (Buccino et al. 2001).

The MNS in humans is directly involved in imitation of simple movements (Iacoboni et al. 1999), in the learning of complex skills through imitation (Buccino, Lui, et al. 2004), in the perception of communicative actions (Buccino, Vogt, et al. 2004), and in the detection of action intentions (Iacoboni et al. 2005). Further, the premotor cortex containing the MNS is involved in processing action-related words and sentences (Hauk, Johnsrude, and Pulvermüller 2004; Tettamanti et al. 2005; Buccino et al. 2005; see also Pulvermüller 2002), suggesting that the MNS together with other parts of the sensorimotor system could play a relevant role in language semantics (Gallese and Lakoff 2005; Gallese 2007a, in press).

Other mirroring mechanisms seem to be involved with our capacity to share emotions and sensations with others (Gallese 2001, 2003a,b, 2006; de Vignemont and Singer 2006; Sommerville and Decety 2006). When perceiving others expressing a given basic emotion by means of their facial mimicry, the observer's facial muscles activate in a congruent manner (Dimberg 1982; Dimberg and Thunberg 1998; Dimberg et al. 2000; Lundqvist and Dimberg 1995), with an intensity proportional to their empathic nature (Sonnby-Borgstrom 2002). Further, both observation and imitation of the facial expression of basic emotions activate the same restricted group of brain structures, including the ventral premotor cortex, the insula, and the amygdala (Carr et al. 2003).

The perception and production of emotion-related facial expressions both impinge on common neural structures whose function can be characterized as that of an embodied simulation mechanism. Finally, in an fMRI study we specifically addressed the issue of how the first- and third-person experiences of a particular emotion are mapped in the human brain. To that purpose, we scanned the brain activity of healthy participants during the phenomenal experience of disgust, by having them inhale disgusting odorants, and during the observation of the same emotion as displayed by video clips of other people dynamically expressing it with their facial expression. The results showed that witnessing the facial expression of disgust in others activates the left anterior insula at the same location activated by the first-person subjective experience of disgust (Wicker et al. 2003).

It appears therefore that there is a *we-centric dimension* in the experience of a given affective state, and that it is underpinned by the activity of a shared neural substrate. When we witness a given facial expression, and this perception leads to understanding that expression as characterized by a particular affective state, we do not accomplish this type of understanding *only* through explicit inference from analogy. The other's emotion is first and foremost constituted and directly understood by means of embodied simulation producing an "as-if" experience engendered by a shared body state. It is the body state shared by observer and observed that enables direct understanding.

Similar direct matching mechanisms have been described for the perception of pain (Hutchison et al. 1999; Singer et al. 2004; Jackson, Meltzoff, and Decety 2005; Botvinick et al. 2005) and touch (Keysers et al. 2004; Blakemore et al. 2005; Ebisch et al. 2008). These results together suggest that our capacity to empathize with others is mediated by embodied simulation mechanisms, that is, by the activation of the same neural circuits underpinning our own emotional and sensory experiences (see Gallese 2003a,b, 2006, 2007b,c; Gallese, Keysers, and Rizzolatti 2004).

Recent studies suggest that these mechanisms could be deficient in individuals affected by Autistic Spectrum Disorder (for review, see Gallese 2003b, 2006; Oberman and Ramachandran 2007). McIntosh et al. (2006) showed that individuals with ASD, unlike healthy controls, do not show automatic mimicry of the facial expression of basic emotions, as revealed by EMG recordings. In a recent fMRI study, Dapretto et al. (2006) specifically investigated the neural correlates of the capacity of imitating the facial expressions of basic emotions in high-functioning ASD individuals. The results of this study showed that during observation and imitation autistic children did not show activation of the MNS in the pars opercularis of the inferior frontal gyrus. It should be emphasized that activity in this area was inversely related with symptom severity in the social domain. The authors of this study concluded that "a dysfunctional mirror neuron system may underlie the social deficits observed in autism" (p. 29).

The specific social cognitive flexibility of our species, as reflected in our pervasive mimetic abilities, in our propensity for pedagogy, and in the sophisticated quality of our social understanding, likely exceeds the functional properties of the MNS. However, I posit that a proper development of the MNS is a necessary prerequisite for scaffolding the development of human social cognitive skills.

EMPATHY AND INTENTIONAL ATTUNEMENT: A NEUROSCIENTIFIC PERSPECTIVE

The results of neuroscientific investigation of the neural bases of interpersonal relations, here concisely and partially summarized, provide a new, empirically based image of intersubjectivity. When witnessing the behavior of others, and facing their full range of *expressive* power (the way they act, the emotions and feelings they display), a meaningful embodied we-centric interpersonal link is automatically established (Gallese 2003a,b, in press; Gallese et al. 2007). The discovery of the MNS and of other mirroring mechanisms in the human brain shows that the very same neural substrate is activated when these expressive acts are either executed or perceived. Thus, we have a subpersonally instantiated common space, a shared manifold of intersubjectivity (Gallese 2001).

The earliest indirect evidence available to date of an MNS in infants comes from a study by Shimada and Hiraki (2006), who demonstrated by means of near infrared spectroscopy (NIRS) the presence of an action execution/observation matching system in six-month-old human infants. It can be hypothesized that an innate rudimental MNS is already present at birth and can henceforth be flexibly modulated by motor/affective experience and gradually enriched by visuomotor learning. Indeed, such a system could be an ideal candidate for the neural underpinning of neonatal facial imitation, originally described in humans by Meltzoff and Moore (1977) and subsequently described in chimpanzees (Myowa-Yamakoshi et al. 2004) and macaque monkeys (Ferrari et al. 2006).

As recently proposed by Lepage and Théoret (2007), the development of the MNS can be conceptualized as a process whereby the child learns to refrain from acting out the automatic matching mechanism linking action perception and execution. Such development could be viewed as a process leading from mandatory reenactment to mandatory embodied simulation.

The hypothesis I am proposing is that a common underlying functional mechanism—embodied simulation—mediates our capacity to share the meaning of actions, intentions, feelings, and emotions with others, thus grounding our identification with and connectedness to others. However, self-other identity is not all there is in empathy. Empathy, unlike emotional contagion, entails the capacity to experience what others do and yet to attribute these shared experiences to others and not to the self. The quality and content of our *Erlebnis* of the external world are constrained by the presence of other subjects who are intelligible, while preserving their alterity. An alterity is present also at the subpersonal level, instantiated by the different neural networks coming into play and/or by their different degree of activation when I act and when others do, or when I experience an emotion or a sensation and when others do the same (see Blakemore et al. 2005).

It must also be stressed that the functional mechanism of embodied simulation is not to be conceived as a rigid, reflex-like input/output coupling. Several brain-imaging studies conducted on human beings have shown that the intensity of MNS activation during action observation depends on the similarity between the observed actions and the participants' action repertoire (Buccino, Lui, et al. 2004; Calvo-Merino et al. 2005). In particular, one fMRI study (Calvo-Merino et al. 2006) focused on the distinction between the relative contribution of visual and motor experience in processing an observed action. The results revealed greater activation of the MNS when the observed actions were frequently performed than when they were perceptually familiar but never practiced.

Every instantiation of mirroring is always a process in which others' behavior is metabolized by and filtered through the observer's idiosyncratic past experiences, capacities, and mental attitudes. More studies will have to investigate the relationship between personality traits and the quantitative and qualitative nature of mirroring mechanisms.

The notion of empathy is today confined mostly to the domain of the psychology of emotions. This attitude is clearly present in the papers by Aragno and Zepf and Hartmann. Yet the neuroscientific evidence presented here and an overview of the philosophical history of the term (Pigman 1995; Steuber 2006; Freedberg and Gallese 2007; Gallese 2003b, in press) suggest that this restriction is arbitrary and reductive. Lipps (1903) discussed the role of empathy in aesthetic experience (see Freedberg and Gallese 2007) and introduced it in psychology, extending the concept of *Einfühlung* to the domain of intersubjectivity, which he characterized in terms of inner imitation of the perceived behavior of others. In Lipps we find the first suggestion of a relation between imitation (though *inner* imitation) and the capacity of understanding others by ascribing to them feelings, emotions, and thoughts. That this notion closely matches Freud's take on empathy (1921) is no surprise, since Freud considered Lipps "the clearest mind among present-day philosophical writers," as he wrote to Fliess in 1898 (Freud 1985, p. 324).[1]

The multidimensional nature of empathy emerges even more clearly within the phenomenological tradition in philosophy. According to Husserl (1931), by means of *Einfühlung* we understand that others are similar to us, without reaching that conclusion through an inference from analogy (p. 141). Edith Stein (1912) asserts that the concept of empathy is not confined to a simple grasp of the other's feelings or emotions. There is a more basic connotation of empathy: the other is experienced as another being as oneself through an appreciation of similarity, also encompassing the domain of action. In the *Phenomenology of Perception,* Merleau-Ponty

[1] For a recent investigation of the relationship between Freud and Lipps, with particular reference to music, see Barale and Minazzi (in press).

(1945) writes that "the sense of the gestures is not given, but understood, that is, recaptured by an act on the spectator's part. The whole difficulty is to conceive this act clearly, without confusing it with a cognitive operation. The communication or comprehension of gestures comes about through the reciprocity of my intentions and the gestures of others, of my gestures and intentions discernible in the conduct of other people. It is as if the other person's intention inhabited my body and mine his" (p. 185). These words clearly anticipate the "embodied cognition" take on intersubjectivity promoted by contemporary research in cognitive neuroscience.

According to my model, and in contrast to what Zepf and Hartmann argue, when we are exposed to the actions performed by others or to the expression of the emotions and sensations they experience, we do not necessarily start from an opaque sensory description of a given behavior to be interpreted and logically analyzed with our cognitive—and disembodied—apparatus. In many everyday life situations the behavior of others is immediately meaningful because it enables a direct link to our own situated lived experience of the world. As posited by Scheler (1954), we understand others' mental states because they are bodily expressed. On the basis of what we are learning from neuroscience, today we can explain why others' behavior is intrinsically meaningful to us: because we share the neural resources on which the same behavior is mapped. The shared we-centric intersubjective space in which we live since birth enables the constitution of the sense of social identity we normally entertain with others.

A common underlying functional mechanism—embodied simulation—mediates our capacity to experientially share the meaning of actions, intentions, feelings, and emotions with others, thus grounding our identification with and connectedness to others. This occurs in a nonconscious, predeclarative fashion, though modulated by our own personal history, that is, by the quality of our attachment relations and by our sociocultural background. Embodied simulation generates our "intentional attunement" to others. This phenomenal state in turn generates a peculiar quality of identification with other individuals. Besides and before being mind readers, we are fundamentally behavior readers (Gallese 2003a,b, 2006, 2007b,c, in press).

CONCLUSIONS

Physical and epistemic social interactions are shaped and conditioned by the same body and environmental constraints. This common relational character is underpinned, at the level of the brain, by shared mirroring neural mechanisms. These neural mechanisms enable the shareable character of actions, emotions, and sensations, the earliest constituents of our social life. We-ness and intersubjectivity ontologically ground the human condition, in which reciprocity foundationally defines human existence (Gallese 2007a,b, in press). The relevance of *Einfühlung* for psychoanalysis, as I have tried to characterize it from a neuroscientific perspective, is twofold. First, it provides an explanatory framework to account for the implicit, prelinguistic dimension of human intersubjectivity. Second, as emphasized by Aragno, it represents a valuable specific technique in psychoanalytic practice, by sharpening "sensibilities to unconscious dynamics."

Embodied simulation—the functional mechanism underpinning *Einfühlung*—is at work within the psychoanalytic setting between patient and analyst (see also Beebe et al. 2005; Gallese, Eagle, and Migone 2007). The interpersonal dynamics related to transference and countertransference can be viewed as instantiations of the implicit and prelinguistic mechanisms occurring within the we-centric space defined by intentional attunement, as created by the embodied simulation-driven mirroring mechanisms here reviewed. Thus, transference and countertransference, typical "as-if" experiences, can be viewed as "two sides of the same analytic coin" (Levine 1994, p. 669), simply by virtue of the functional mechanisms that characterize them at the subpersonal level.

The contribution offered by cognitive neuroscience to the psychoanalytic debate on the nature of the analytic relation and of intersubjectivity is in my opinion perfectly consonant with the original Freudian project of grounding the understanding of human psychic life on its neurobiological substrate. According to Freud (1923), the ego is a mental projection of the body, a *Körper-Ich*. As stated by Resnik (2001), the unconscious is a virtual place, representative of an archaic function, articulated in a language solely expressed through existential corporality, by means of the expressive power of gestures, of our "body masks." Following Resnik, the process of personalization can be conceived as the outcome of our bodily experience, which requires the existence of the other. A normal interpersonal relation can therefore be phenomenologically expressed as a *movement* in which the body's intentions are "dramatized," acted out in manifest behavior.

Cognitive neuroscience has started to unveil the neural mechanisms enabling the meaningful expression of intersubjectivity. The ever growing contemporary dialogue between cognitive neuroscience and psychoanalysis should hopefully lead to the formulation of a new common language, since both disciplines describe from different perspectives and with different heuristic tools the same object, the dynamic embodied nature of human existence.

REFERENCES

BARALE, F., & MINAZZI, V. (in press). Dead ends: Freud, sound, and music. Statement of a problem and some historico-critical notes. *International Journal of Psychoanalysis*.

BEEBE, B., KNOBLAUCH, S., RUSTIN, J., & SORTER, D. (2005). *Forms of Intersubjectivity in Infant Research and Adult Treatment*. New York: Other Press.

BLAKEMORE, S.-J., BRISTOW, D., BIRD, G., FRITH, C., & WARD, J. (2005). Somatosensory activations during the observation of touch and a case of vision–Touch synaesthesia. *Brain* 128:1571–1583.

BOTVINICK, M., JHA, A.P., BYLSMA, L.M., FABIAN, S.A., SOLOMON, P.E., & PRKACHIN, K.M. (2005). Viewing facial expressions of pain engages cortical areas involved in the direct experience of pain. *NeuroImage* 25:315–319.

BUCCINO, G., BINKOFSKI, F., FINK, G.R., FADIGA, L., FOGASSI, L., GALLESE, V., SEITZ, R.J., ZILLES, K., RIZZOLATTI, G., & FREUND, H.-J. (2001). Action observation activates premotor and parietal areas in a somatotopic manner: An fMRI study. *European Journal of Neuroscience* 13:400–404.

——— LUI, F., CANESSA, N., PATTERI, I., LAGRAVINESE, G., BENUZZI, F., PORRO, C.A., & RIZZOLATTI, G. (2004). Neural circuits involved in the recognition of actions performed by nonconspecifics: An fMRI study. *Journal of Cogniive Neuroscience* 16:114–126.

——— RIGGIO, L., MELLI, G., BINKOFSKI, F., GALLESE, V., & RIZZOLATTI, G. (2005). Listening to action-related sentences modulates the activity of the motor system: A combined TMS and behavioral study. *Cognitive Brain Research* 24:355–363.

——— VOGT, S., RITZL, A., FINK, G.R., ZILLES, K., FREUND, H.-J., & RIZZOLATTI, G. (2004). Neural circuits underlying imitation learning of hand actions: An event-related fMRI study. *Neuron* 42:323–334.

CALVO-MERINO, B., GLASER, D.E., GRÈZES, J., PASSINGHAM, R.E., & HAGGARD, P. (2005). Action observation and acquired motor skills: An fMRI study with expert dancers. *Cerebral Cortex* 15:1243–1249.

——— GRÈZES, J., GLASER, D.E., PASSINGHAM, R.E., & HAGGARD, P. (2006). Seeing or doing? Influence of visual and motor familiarity in action observation. *Current Biology* 16(19):1905–1910.

Carr, L., Iacoboni, M., Dubeau, M.C., Mazziotta, J.C., & Lenzi, G.L. (2003). Neural mechanisms of empathy in humans: A relay from neural systems for imitation to limbic areas. *Proceedings of the National Academy of Science USA* 100(9):5497–5502.

Dapretto, L., Davies, M.S., Pfeifer, J.H., Scott, A.A., Sigman, M., Bookheimer, S.Y., & Iacoboni, M. (2006). Understanding emotions in others: Mirror neuron dysfunction in children with autism spectrum disorders. *Nature Neuroscience* 9:28–30.

de Vignemont, F., & Singer, T. (2006). The empathic brain: How, when, and why? *Trends in the Cognitive Sciences* 10:435–441.

Dimberg, U. (1982). Facial reactions to facial expressions. *Psychophysiology* 19:643–647.

——— & Thunberg, M. (1998). Rapid facial reactions to emotionally relevant stimuli. *Scandinavian Journal of Psychology* 39:39–46.

——— ——— & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science* 11:86–89.

Ebisch, S.J.H., Perrucci, M.G., Ferretti, A., Del Gratta, C., Romani, G.L., & Gallese, V. (2008). The *sense* of touch: Embodied simulation in a visuotactile mirroring mechanism for the sight of any touch. *Journal of Cognitive Neuroscience*, March 17 [Epub ahead of print], PMID: 18345991.

Ferrari, P.F., Visalberghi, E., Paukner, A., Fogassi, L., Ruggiero, A., et al. (2006). Neonatal imitation in rhesus macaques. *PLOS Biology* 4(9):302.

Freedberg D., & Gallese V. (2007). Motion, emotion and empathy in esthetic experience. *Trends in the Cognitive Sciences* 11:197–203.

Freud, S. (1921). Group psychology and the analysis of the ego. *Standard Edition* 18:65–143.

——— (1923). The ego and the id. *Standard Edition* 19:1–66.

——— (1985). *The Complete Letters of Sigmund Freud to Wilhelm Fliess 1897–1904*, ed. J.M. Masson. Cambridge: Harvard University Press.

Gallese, V. (2001). The "shared manifold" hypothesis: From mirror neurons to empathy. *Journal* of *Consciousness Studies* 8(5–7)33–50.

——— (2003a). The manifold nature of interpersonal relations: The quest for a common mechanism. *Philosophical Transactions of the Royal Society of London Series B* 358:517–528.

——— (2003b). The roots of empathy: The shared manifold hypothesis and the neural basis of intersubjectivity. *Psychopathology* 36(4):171–180.

——— (2006). Intentional attunement: A neurophysiological perspective on social cognition and its disruption in autism. *Experimental Brain Research / Cognitive Brain Research* 1079:15–24.

——— (2007a). Before and below 'theory of mind': Embodied simulation and the neural correlates of social cognition. *Philosophical Transactions of the Royal Society of London Series B* 362:659–669.

——— (2007b). Empathy, embodied simulation and mirroring mechanisms; Commentary on "Towards a neuroscience of empathy" by Doug Watt. *Neuro-Psychoanalysis* 9:146–151.

——— (2007c). The shared manifold hypothesis: Embodied simulation and its role in empathy and social cognition. In *Empathy in Mental Illness and Health,* ed. T.F.D. Farrow & P.W.R. Woodruff. Cambridge: Cambridge University Press, pp. 448–472.

——— (in press). Mirror neurons, embodied simulation, and the neural basis of social identification. *Psychoanalytic Dialogues.*

——— Eagle, M.N., & Migone, P. (2007). Intentional attunement: Mirror neurons and the neural underpinnings of interpersonal relations. *Journal of the American Psychoanalytic Association* 55:131–176.

——— Fadiga, L., Fogassi, L., & Rizzolatti, G. (1996). Action recognition in the premotor cortex. *Brain* 119:593–609.

——— Keysers, C., & Rizzolatti, G. (2004). A unifying view of the basis of social cognition. *Trends in the Cognitive Sciences* 8:396–403.

——— & Lakoff, G. (2005). The brain's concepts: The role of the sensory-motor system in reason and language. *Cognitive Neuropsychology* 22:455–479.

Hauk, O., Johnsrude, I., & Pulvermüller, F. (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron* 41:301–307.

Husserl, E. (1931). *Cartesian Meditations,* transl. D. Cairns. The Hague: Martinus Nijhoff, 1969.

Hutchison, W.D., Davis, K.D., Lozano, A.M., Tasker, R.R., & Dostrovsky, J.O. (1999). Pain-related neurons in the human cingulate cortex. *Nature Neuroscience* 2:403–405.

Iacoboni, M., Molnar-Szakacs, I., Gallese, V., Buccino, G., Mazziotta, J., & Rizzolatti, G. (2005). Grasping the intentions of others with one's own mirror neuron system. *PLOS Biology* 3:529–535.

——— Woods, R.P., Brass, M., Bekkering, H., Mazziotta, J.C., & Rizzolatti, G. (1999). Cortical mechanisms of human imitation. *Science* 286:2526–2528.

Jackson, P.L., Meltzoff, A.N., & Decety, J. (2005). How do we perceive the pain of others? A window into the neural processes involved in empathy. *NeuroImage* 24:771–779.

Keysers, C., Wickers, B., Gazzola, V., Anton, J.-L., Fogassi, L., & Gallese, V. (2004). A touching sight: SII/PV activation during the observation and experience of touch. *Neuron* 42:1–20.

Lepage, J.F., & Théoret, H. (2007). The mirror neuron system: Grasping others' actions from birth? *Developmental Science* 10(5):513–529.

Levine, H.B. (1994). The analyst's participation in the analytic process. *International Journal of Psychoanalysis* 75:665–675.

LIPPS, T. (1903). Einfühlung, innere nachahmung und organenempfindung. *Archiv für die gesammte Psychologie,* vol I, part 2. Leipzig: W. Engelmann.

LUNDQVIST, L., & DIMBERG, U. (1995). Facial expressions are contagious. *Journal of Psychophysiology* 9:203–211.

MCINTOSH, D.N., REICHMAN-DECKER, A., WINKIELMAN, P., & WILBARGER, J. (2006). When the social mirror breaks: Deficits in automatic, but not voluntary mimicry of emotional facial expressions in autism. *Developmental Science* 9:295–302.

MELTZOFF, A.N., & MOORE, M.K. (1977). Imitation of facial and manual gestures by human neonates. *Science* 198:75–78.

MERLEAU-PONTY, M. (1945). *Phenomenology of Perception,* transl. C. Smith. London: Routledge, 1962.

MYOWA-YAMAKOSHI, M., TOMONAGA, M., TANAKA, M., & MATSUZAWA, T. (2004). Imitation in neonatal chimpanzees (Pan troglodytes). *Developmental Science* 7:437–442.

OBERMAN, L.M., & RAMACHANDRAN, V.S. (2007). The simulating social mind: Mirror neuron system and simulation in the social and communicative deficits of Autism Spectrum Disorder. *Psychological Bulletin* 133:310–327.

PIGMAN, G.W. (1995). Freud and the history of empathy. *International Journal of Psychoanalysis* 76:237–252.

PULVERMÜLLER, F. (2002). *The Neuroscience of Language*. Cambridge: Cambridge University Press.

RESNIK, S. (2001). *The Delusional Person: Bodily Feelings in Psychosis*. London: Karnac Books.

RIZZOLATTI, G., & CRAIGHERO, L. (2004). The mirror neuron system. *Annual Review of Neuroscience* 27:169–192.

——— FADIGA, L., GALLESE, V., & FOGASSI, L. (1996). Premotor cortex and the recognition of motor actions. *Cognitive Brain Research* 3:131–141.

——— FOGASSI, L., & GALLESE, V. (2001). Neurophysiological mechanisms underlying the understanding and imitation of action. *Nature Neuroscience Reviews* 2:661–670.

SCHELER, M. (1954). *The Nature of Sympathy,* transl. P. Heath. London: Routledge & Keegan Paul, 1973.

SHIMADA, S., & HIRAKI, K. (2006). Infant's brain responses to live and televised action. *NeuroImage* 32:930–939.

SINGER, T., SEYMOUR, B., O'DOHERTY, J., KAUBE, H., DOLAN, R.J., & FRITH, C.F. (2004). Empathy for pain involves the affective but not the sensory components of pain. *Science* 303:1157–1162.

SOMMERVILLE, J.A., & DECETY, J. (2006). Weaving the fabric of social interaction: Articulating developmental psychology and cognitive neuroscience in the domain of motor cognition. *Psychonomics Bulletin Review* 13:179–200.

SONNBY-BORGSTROM, M. (2002). Automatic mimicry reactions as related to differences in emotional empathy. *Scandinavian Journal of Psychology* 43:433–443.

STEIN, E. (1912). *On the Problem of Empathy*. The Hague: Martinus Nijhoff, 1964.

STEUBER, K.R. (2006). *Rediscovering Empathy: Agency, Folk Psychology and the Human Sciences*. Cambridge: MIT Press.

TETTAMANTI, M., BUCCINO, G., SACCUMAN, M.C., GALLESE, V., DANNA, M., SCIFO, P., FAZIO, F., RIZZOLATTI, G., CAPPA, S.F., & PERANI, D. (2005). Listening to action-related sentences activates fronto-parietal motor circuits. *Journal of Cognitive Neuroscience* 17:273–281.

WICKER, B., KEYSERS, C., PLAILLY, J., ROYET, J.-P., GALLESE, V., & RIZZOLATTI, G. (2003). Both of us disgusted in my insula: The common neural basis of seeing and feeling disgust. *Neuron* 40:655–664.

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