Vittorio Gallese - selected references

1 Gallese, V. (2014). Bodily selves in relation: embodied simulation as second-person perspective on intersubjectivity. *Philos.Trans.R.Soc.Lond B Biol.Sci., 369,* 20130177.
Notes: This article addresses basic aspects of social cognition focusing on the pivotal role played by the lived body in the constitution of our experience of others. It is suggested that before studying intersubjectivity we should better qualify the notion of the self. A minimal notion of the self, the bodily self, defined in terms of its motor potentialities, is proposed. The discovery of mirror mechanisms for action, emotions and sensations led to the proposal of an embodied approach to intersubjectivity-embodied simulation (ES) theory. ES and the related notion of neural reuse provide a new empirically based perspective on intersubjectivity, viewed first and foremost as intercorporeality. ES challenges the notion that folk psychology is the sole account of interpersonal understanding. ES is discussed within a second-person perspective on mindreading

2 Heimann, K., Umilta, M. A., & Gallese, V. (2013). How the motor-cortex distinguishes among letters, unknown symbols and scribbles. A high density EEG study. *Neuropsychologia, 51,* 2833-2840.
Notes: Previous research has reported that the perception of written language symbols activates the cortical motor hand representation of the dominant hemisphere also found to be activated during the writing of these symbols. It has been suggested that such motor activation supports reading. Nevertheless, the precise circumstances leading to such activation are still unknown. For instance, several studies suggested that motor activation necessarily depends on specific sensory-motor experience with the stimuli. Some results, however, also indicated that untrained stimuli can elicit the response. Moreover, due to the methods used so far, little is known about the temporal course of the motor activity. Our study explored these open questions using high-density EEG. We measured central alpha event-related desynchronization (ERD) as a marker of cortical motor activation during the observation of Roman letters (alphabet of participants' mother language), Chinese characters (not familiar to participants), and scribbles. Our results show that the cortical motor system is activated during the perception of all three stimuli in both hemispheres, with ERD stronger in the left (dominant) hemisphere. A significant difference of ERD time-course was observed in the left hemisphere between the observation of symbols (letters and characters) and scribbles. Scribbles elicited significantly faster resynchronization of central alpha than symbols. We suggest that ERD results are due to recognizing all stimuli as traces of hand gestures. Furthermore, differences in ERD found between symbols and scribbles might depend either on visuo-motor training, separating symbols from scribbles, or on stimuli specific features marking their status as either language symbols or scribbles

3 Gallese, V. (2013). Mirror neurons, embodied simulation and a second-person approach to mindreading. *Cortex, 49,* 2954-2956.

4 Umilta', M. A., Berchio, C., Sestito, M., Freedberg, D., & Gallese, V. (2012). Abstract art and cortical motor activation: an EEG study. *Front Hum.Neurosci., 6,* 311.
Notes: The role of the motor system in the perception of visual art remains to be better understood. Earlier studies on the visual perception of abstract art (from Gestalt theory, as in Arnheim, 1954 and 1988, to balance preference studies as in Locher and Stappers, 2002, and more recent work by Locher et al., 2007; Redies, 2007, and Taylor et al., 2011), neglected the question, while the field of neuroesthetics (Ramachandran and Hirstein, 1999; Zeki, 1999) mostly concentrated on figurative works. Much recent work has demonstrated the multimodality of vision, encompassing the activation of motor, somatosensory, and viscero-motor brain regions. The present study investigated whether the observation of high-resolution digitized static images of abstract paintings by Lucio Fontana is associated with specific cortical motor activation in the beholder's brain. Mu rhythm suppression was evoked by the observation of original art works but not by control stimuli (as in the case of graphically modified versions of these works). Most interestingly, previous visual exposure to the stimuli did not affect the mu rhythm suppression induced by their observation. The present results clearly show the involvement of the cortical motor system in the viewing of static abstract art works

5 Massaro, D., Savazzi, F., Di, D. C., Freedberg, D., Gallese, V., Gilli, G. et al. (2012). When art moves the eyes: a behavioral and eye-tracking study. *PLoS.ONE., 7,* e37285.
Notes: The aim of this study was to investigate, using eye-tracking technique, the influence of bottom-up and top-down processes on visual behavior while subjects, naive to art criticism, were presented with representational paintings. Forty-two subjects viewed color and black and white paintings (Color) categorized as dynamic or static (Dynamism) (bottom-up processes). Half of the images represented natural environments and half human subjects (Content); all stimuli were displayed under aesthetic and movement judgment conditions (Task) (top-down processes). Results on gazing behavior showed that content-related top-down processes prevailed over low-level visually-driven bottom-up processes when a human subject is represented in the painting. On the contrary, bottom-up processes, mediated by low-level visual features, particularly affected gazing behavior when looking at nature-content images. We discuss our results proposing a reconsideration of the definition of content-related top-down processes in accordance with the concept of embodied simulation in art perception

6 Marino, B. F., Gallese, V., Buccino, G., & Riggio, L. (2012). Language sensorimotor specificity modulates the motor system. *Cortex, 48,* 849-856.
Notes: Embodied approaches to language understanding hold that comprehension of linguistic material entails a situated simulation of the situation described. Some recent studies have shown that implicit, explicit, and relational properties of objects implied in a sentence are part of this simulation. However, the issue concerning the extent to which language sensorimotor specificity expressed by linguistic constituents of a sentence, contributes to situating the simulation process has not yet been adequately addressed. To fill this gap, we combined a concrete action verb with a noun denoting a graspable or non-graspable object, to form a sensible or non-sensible sentence. Verbs could express a specific action with low degrees of freedom (DoF) or an action with high DoF. Participants were asked to respond indicating whether the sentences were sensible or not. We found that simulation was active in understanding both sensible and non-sensible sentences. Moreover, the simulation was more situated with sentences containing a verb referring to an action with low DoF. Language sensorimotor specificity expressed by the noun, played a role in situating the simulation, only when the noun was preceded by a verb denoting an action with high DoF in sensible sentences. The simulation process in understanding non-sensible sentences evoked both the representations related to the verb and to the noun, these remaining separated rather than being integrated as in sensible sentences. Overall our findings are in keeping with embodied approaches to language understanding and suggest that the language sensorimotor specificity of sentence constituents affects the extent to which the simulation is situated

7 Jezzini, A., Caruana, F., Stoianov, I., Gallese, V., & Rizzolatti, G. (2012). Functional organization of the insula and inner perisylvian regions. *Proceedings of the National Academy of Sciences of the United States of America, 109,* 10077-10082.
Notes: In the last few years, the insula has been the focus of many brain-imaging studies, mostly devoted to clarify its role in emotions and social communication. Physiological data, however, on which one may ground these correlative findings are almost totally lacking. Here, we investigated the functional properties of the insular cortex in behaving monkeys using intracortical microstimulation. Behavioral responses and heart rate changes were recorded. The results showed that the insula is functionally formed by two main subdivisions: (i) a sensorimotor field occupying the caudal-dorsal portion of the insula and appearing as an extension of the parietal lobe; and (ii) a mosaic of orofacial motor programs located in the anterior and centroventral insula sector. These programs show a progressive shift from dorsally located nonemotional motor programs (ingestive activity) to ventral ones laden with emotional and communicative content. The relationship between ingestive and other behaviors is discussed in an evolutionary perspective

8 Glenberg, A. M. & Gallese, V. (2012). Action-based language: a theory of language acquisition, comprehension, and production. *Cortex, 48,* 905-922.
Notes: Evolution and the brain have done a marvelous job solving many tricky problems in action control, including problems of learning, hierarchical control over serial behavior, continuous recalibration, and fluency in the face of slow feedback. Given that evolution tends to be conservative, it should not be surprising that these solutions are exploited to solve other tricky problems, such as the design of a communication system. We propose that a mechanism of motor control, paired controller/predictor models, has been exploited for language learning, comprehension, and production. Our account addresses the development of grammatical regularities and perspective, as well as how linguistic symbols become meaningful through grounding in perception, action, and emotional systems

9 Gallese, V. & Sinigaglia, C. (2011). What is so special about embodied simulation? *Trends in Cognitive Sciences, 15,* 512-519.
Notes: Simulation theories of social cognition abound in the literature, but it is often unclear what simulation means and how it works. The discovery of mirror neurons, responding both to action execution and observation, suggested an embodied approach to mental simulation. Over the past few years this approach has been hotly debated and alternative accounts have been proposed. We discuss these accounts and argue that they fail to capture the uniqueness of embodied simulation (ES). ES theory provides a unitary account of basic social cognition, demonstrating that people reuse their own mental states or processes represented with a bodily format in functionally attributing them to others

10 Gallese, V. & Sinigaglia, C. (2010). The bodily self as power for action. *Neuropsychologia, 48,* 746-755.
Notes: The aim of our paper is to show that there is a sense of body that is enactive in nature and that enables to capture the most primitive sense of self. We will argue that the body is primarily given to us as source or power for action, i.e., as the variety of motor potentialities that define the horizon of the world in which we live, by populating it with things at hand to which we can be directed and with other bodies we can interact with. We will show that this sense of body as bodily self is, on the one hand, antecedent the distinction between sense of agency and sense of ownership, and, on the other, it enables and refines such distinction, providing a conceptual framework for the coherent interpretation of a variety of behavioral and neuropsychological data. We will conclude by positing that the basic experiences we entertain of our selves as bodily selves are from the very beginning driven by our interactions with other bodies as they are underpinned by the mirror mechanism

11 Rizzolatti, G., Fogassi, L., & Gallese, V. (2009). The mirror neuron system: A motor-based mechanism for action and intention understanding. In M.S.Gazzaniga (Ed.), *The cognitive neurosciences* (4 ed., pp. 625-640). Cambridge,MA: MIT Press.

12 Gallese, V. (2008). Mirror neurons and the social nature of language: the neural exploitation hypothesis. *Social neuroscience, 3,* 317-333.
Notes: This paper discusses the relevance of the discovery of mirror neurons in monkeys and of the mirror neuron system in humans to a neuroscientific account of primates' social cognition and its evolution. It is proposed that mirror neurons and the functional mechanism they underpin, embodied simulation, can ground within a unitary neurophysiological explanatory framework important aspects of human social cognition. In particular, the main focus is on language, here conceived according to a neurophenomenological perspective, grounding meaning on the social experience of action. A neurophysiological hypothesis--the "neural exploitation hypothesis"--is introduced to explain how key aspects of human social cognition are underpinned by brain mechanisms originally evolved for sensorimotor integration. It is proposed that these mechanisms were later on adapted as new neurofunctional architecture for thought and language, while retaining their original functions as well. By neural exploitation, social cognition and language can be linked to the experiential domain of action University of Parma, Parma, Italy. vittorio.gallese@unipr.it

13 Freedberg, D. & Gallese, V. (2007). Motion, emotion and empathy in esthetic experience. *Trends in Cognitive Sciences, 11,* 197-203.
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The implications of the discovery of mirroring mechanisms and embodied simulation for empathetic responses to images in general, and to works of visual art in particular, have not yet been assessed. Here, we address this issue and we challenge the primacy of cognition in responses to art. We propose that a crucial element of esthetic response consists of the activation of embodied mechanisms encompassing the simulation of actions, emotions and corporeal sensation, and that these mechanisms are universal. This basic level of reaction to images is essential to understanding the effectiveness both of everyday images and of works of art. Historical, cultural and other contextual factors do not preclude the importance of considering the neural processes that arise in the empathetic understanding of visual artworks

14 Gallese, V., Keysers, C., & Rizzolatti, G. (2004). A unifying view of the basis of social cognition. *Trends in Cognitive Sciences, 8,* 396-403.
Notes: In this article we provide a unifying neural hypothesis on how individuals understand the actions and emotions of others. Our main claim is

that the fundamental mechanism at the basis of the experiential understanding of others' actions is the activation of the mirror neuron system. A similar mechanism, but involving the activation of viscero-motor centers, underlies the experiential understanding of the emotions of others

15 Gallese, V. (2003). The maniforld nature of interpersonal relations: the quest for a common mechanism. In C.D.Frith & D. M. Wolpert (Eds.), *The neuroscience of social interaction: decoding, imitating, and influencing the actions of others* (1 ed., pp. 159-182). Oxford: Oxford University Press.