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Brain, Body, Habit and the Performative Quality of Aesthetics

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Abstract: If cognitive neuroscience is meant to investigate what makes us human, cultural artifacts and artistic expressions should be at the top of the list of its *explananda.* Cognitive neuroscience, in tight cooperation and dialogue with the humanities, can shed new light on several theoretical issues related to aesthetics, traditionally dealt with exclusively within the camp of the humanities. A succinct description of embodied simulation theory in relation to aesthetic experience is proposed, and some accomplishments of this bottom-up approach to the experience of visual art and film are illustrated. The notion of 'habit' is introduced, it is connected to its potential underlying neural mechanisms, and to the production and reception of human cultural artifacts. Capitalizing upon Pragmatism, Pierre Bourdieu and practice theory, the relationship between body, habit, practice, rituals and its bearing on the creation of symbolic objects and cultural artifacts is analyzed from a neuro-pragmatist approach, which emphasizes the procedural and implicit forms of human cognition. The suggested gradual transition from tool-making to symbol-making, grants the following: 1) It shows that utilitarian and symbolic behavior are both chapters of the same cognitive technology trajectory; 2) It doesn't require one to assume that symbol-making is the late externalization of a previously existing inner symbolic thought, because symbolic thought and symbol-making are the co-constructive outcome of the development of shared performative practices and habits; 3) It is fully compatible with the neurobiological characterization of human relational potentialities as instantiated by embodied simulation. It is proposed that through the repetition, combination and memorization of particular shared behaviors and actions, and their mimetic ritualization, the social group infuses new cultural meanings into reused bodily performances. **Keywords**: Aesthetic experience; cultural artifacts; embodied simulation; mirror mechanisms; practice theory; symbol-making

Introduction

> "[…] aesthetics is not merely a matter of constructing theories of something called aesthetic experience, but instead extends broadly to encompass all the processes by which we enact meaning through perception, bodily movement, feeling, and imagination. In other words, all meaningful experience is aesthetic experience" (Mark Johnson 2018: 2).

Is it legitimate and/or worth for neuroscience to study aesthetics, artistic expressions and their reception? As neuroscientist, I've been asked this question many times, both from scholars in the humanities and in neuroscience: often these questions betrayed the interlocutor's preconceived negative answer. I think, however, that there are very good reasons not to be discouraged by such negative attitudes. As argued many times before (Freedberg and Gallese 2007; Gallese 2011, 2016, 2017a, 2018a, b), I think it is not only legitimate but also necessary for neuroscience to extend its field of empirical investigation to the aesthetic dimension of life.

There is, indeed, one compelling reason justifying this determination: If cognitive neuroscience is meant to investigate what makes us human, cultural artifacts and artistic expressions, a

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trademark of the human, should be at the top of the list of the *explananda*. Cognitive neuroscience, in tight cooperation and dialogue with the humanities, can foster and promote new knowledge and shed new light on several theoretical issues related to aesthetics, traditionally dealt with exclusively within the camp of the humanities.

Mainstream neuroscience in the last two decades has investigated the neurobiological basis of the appreciation of beauty and art, with different approaches to address a number of different issues and questions. I personally privileged the study of the brain-body in relation to artistic expressions, to understand the constitutive elements of aesthetic experience of visual art and film and the genesis of aesthetic concepts (for review, see Gallese 2017, 2018a, b, 2019; Gallese and Guerra 2019).

In the next sections, a succinct description of embodied simulation theory in relation to aesthetic experience is proposed, and some accomplishment of this bottom-up approach to the experience of visual art and film are illustrated. In the final part of the chapter, I complement the proposed model of aesthetic reception with a tentative approach to the creative side of aesthetics. I introduce the notions of habit, ritual, and repetition, as proposed by Pragmatism, Pierre Bourdieu and practice theory, and connect them to symbol-making. I show how these theories, in spite of their differences, all share a common interest for the pragmatic aspects of cognition, emphasizing the procedural and implicit forms of knowledge. The purpose is to sketch few elements of a minimalist neurobiologically plausible hypothesis on the 'invention' of symbolic objects, the starting point leading to what we today call art and fiction.

Mirror Neurons, Embodied Simulation and Aesthetic Experience

In the last two decades, an unconventional approach to the aesthetic experience of works of art was proposed and pursued empirically. The unconventionality of this approach stemmed from three starting assumptions, quite different from the standard mainstream approach of neuroscience to aesthetics: 1) Aesthetic experience must be framed within the broader notions of social cognition and intersubjectivity, as works of art are mediators of the relationship between the subjectivities of artists and beholders; 2) The aesthetics of images traditionally relies upon a unimodal notion of vision, conceived as the expression of the visual part of the brain; however, contemporary neuroscience proposes a radically different notion of vision, conceived as the expression of multimodal integration processes, whose key player is the motor system (Gallese 2007, 2014; Gallese 2009; Gallese and Cuccio 2015); 3) Neuroscience revolutionized the notions of perception and imagination, by showing how much both depend upon embodied simulation mechanisms and, more generally, by revealing the tight relation between action, perception and cognition (Gallese 2000, 2007, 2009, 2014; Gallese and Cuccio 2015). Cognitive abilities, like the mapping of space and its perception, the perception of objects occupying our visual landscape, the hierarchical representation of action course towards a distal outcome, the detection of motor goals and action anticipation, are all possible because of the peculiar functional architecture of the motor system, organized in terms of goal-directed motor acts. The proper development of this functional architecture scaffolds more cognitively sophisticated social cognitive abilities, like the production/reception of cultural artifacts and fictional worlds (see Gallese 2017a, 2019).

The multimodal integration of what we perceive is triggered by the potentiality for action that we express corporeally. Humans map non-verbally their surrounding space, have similar non-verbal relationships with objects and other living individuals. Embodied simulation describes, from a functional standpoint, the neural mechanisms that ensure our connections with the world

around us, forming a dialectical relationship between the body and the mind, between subject and object, between you and me. Embodied simulation underlies important aspects of empathy but cannot be identified with it, because it has wider and more diversified areas of application (Gallese 2017a, 2018 a,b, 2019; Gallese and Guerra 2019).

The discovery in the brain of macaques of mirror neurons, neurons that are active both during the execution of actions and their observation when performed by others (Gallese et al. 1996; Rizzolatti et al. 1996), and the following discovery of mirror mechanisms in the human brain (see Gallese et al. 2004; Rizzolatti and Sinigaglia 2008; see also Gallese 2007, 2014, 2016), demonstrate that a *direct* access to the meaning of others' behavior is available, without explicitly attributing propositional attitudes to others. In many circumstances, we do not ascribe intentions to others; we simply detect them by means of motor simulation, that is, by activating part of the motor system without moving our body.

The discovery of mirror mechanisms for action in humans led to the hypothesis that similar functional mechanisms could in principle also apply to the domain of emotions and sensations (Goldman and Gallese 2000; Gallese 2003). The ensuing empirical evidence confirmed this hypothesis. Different mirror mechanisms are involved in our ability to recognize the emotions and sensations of others: the very same neural networks activated during the subjective experience of emotions and sensations are also activated when similar emotions and sensations are detected in others (for a review, see Gallese and Cuccio 2015; Gallese and Guerra 2019). I proposed to qualify these mirror mechanisms as the expression of the same functional mechanism: embodied simulation.

Embodied simulation theory employs a notion of embodiment according to which mental states or processes are embodied because of their bodily format (Gallese 2003, 2005, 2007, 2014). The bodily format of a mental map constrains what such mental map can refer to, because of the bodily constraints posed by the specific nature of the human body. Similar constraints apply both to the mapping of one's own actions, emotions or sensations, as to those of others. Hence, embodied simulation is the reuse of mental states and processes involving mappings that have a bodily format. Sensorimotor systems, originally evolved to guide our interactions with the world, once decoupled from the common final motor pathway and dynamically reconnected with other cortical areas, can serve newly acquired cognitive skills, like understanding others. The experience of our actions, emotions and sensations, and of those of others, always takes place within a we-centric dimension (see Gallese 2001, 2003).

The activation of embodied simulation is the recall of the background bodily knowledge we acquire during our factual relation to the world of inanimate objects and of other sentient beings. We also recruit this knowledge when remembering past experiences, when planning future actions, when engaging in fictional experiences, and when comprehending linguistic descriptions of facts, actions, and events (see Gallese and Cuccio 2015). Indeed, also when we read or listen to narratives we literally embody them by activating part of our sensory-motor system. The activation of motor maps in the brain of the reader or listener has been demonstrated at the phono-articulatory level, as well as during the processing of action-related linguistic expressions (words and sentences) and of morpho-syntactical aspects of language (for review, see Pulvermüller 2005; Gallese 2008; Glenberg and Gallese 2012). This evidence points to a causal role of embodied simulation in language processing and understanding, thus opening up new interesting research scenarios that can be applied to the reception of fictional narrative (see Wojciehowski and Gallese 2011, 2018).

Embodied Simulation and Imagination

Mirror mechanisms are just *one* instantiation of embodied simulation: when mirror mechanisms are activated, the simulation process is triggered by perception, like when observing someone performing an action, expressing an emotion, or undergoing a somatosensory stimulation. However, embodied simulation can also occur when we imagine perceiving something or imagine doing something. When imagining a visual scene, we activate the same cortical visual areas that are active when we factually perceive the same visual scene. Similarly, mental motor imagery of action and factual action both activate a common network of cortical and sub-cortical motor centers, such as the primary motor cortex, the premotor cortex, the supplementary motor area (SMA), the basal ganglia and the cerebellum (for review, see Wojciehowski and Gallese 2011). A high-density EEG study from our lab showed that the brain circuits that inhibit action execution within a go/no-go paradigm are partly the same as those allowing us to imagine to act without moving our body (Angelini et al. 2015).

This evidence shows that visual and motor mental imagery are not exclusively symbolic and propositional. They both rely on and depend upon the activation of sensorimotor brain regions. Visual imagery is somehow equivalent to simulating an actual visual experience, and motor imagery is somehow equivalent to simulating an actual motor experience. When indulging in visual or mental motor imagery, we re-use our visual or motor neural apparatus to imagine things and situations we are not actually perceiving or doing. In sum, visual and motor imagery do qualify as further forms of embodied simulation (Gallese 2011).

The border separating real and imaginary worlds appears rather thin, when viewed from the vantage point of the brain. The similarity between brain's responses to real and fictional events transpires even at the level of single neurons in macaques, a primate species that predates the evolution of language. Caggiano et al. (2011) showed that macaques' mirror neurons respond both to the observation of actions performed by the experimenter physically present in front of them, and to their filmed video clips displayed on a computer screen. Thus, the neurobiological mechanisms connecting us to the 'real world,' largely overlap with those mapping the worlds of fiction.

As aptly pointed out by Italo Testa (2017), John Dewey can be considered as an anticipator of the interpretation of imagination as embodied cognition. Testa emphasizes that "Dewey, while for instance analysing the activity of drawing, sharply criticizes the representational model of imagery which opposes the representational content – the idea, the material to be conveyed – and the mode of expression – the mode of conveyance, the bodily format of the natural physical and psychical process of expression. The "motor expression" is assumed by Dewey to be not just a contextual or enabling condition, but rather a constitutive element of the representational content, of the idea to be expressed." (Testa, 2017: 105). In Dewey's essay published in 1896, he develops the notion of imagination in terms of motor imagery, "imagery of all kinds has a tendency to overflow in the motor channels", "a tendency to reproduce through action and experience" (Dewey 1972: 194).

The implications for cultural artifacts and their reception are great. Embodied simulation can account for how we perceive the world and for how we imagine it, or for how we build a world of fiction and experience it. I proposed that the world of cultural artifacts be 'felt' not too differently from how we feel the world encountered in daily life: we feel for and empathize with fictional images and characters in ways that are similar to how we feel for our real social partners, although with qualifying differences (see Gallese 2011, 2017a,b, 2018b; Gallese and Guerra, 2019). These ideas were systematically probed and tested in a series of experiments investigating the reception of visual art and film, as summarized in the next sections.

Aesthetic Experience as a Mediated Form Of Intersubjectivity: Embodied Simulation and Visual Art

In the second half of the XIX century Adolf von Hildebrand (1893) maintained that when beholding (artistic) images, the perception of their spatiality is the result of a constructive sensorimotor process. According to von Hildebrand, the value of a work of art lies in the ability to establish a relationship between the artist's intention and the observer's reconstruction of it, thus establishing a direct relationship between the creation of the object and the artistic pleasure it produces. Hildebrand proposed that knowing the object is equivalent to knowing the process by which it has been created. Another of von Hildebrand's ideas is even more in line with the hypothesis put forward here: our experience of observed images shares with intersubjectivity the simulation of another intentional subjectivity: that of the artist. This simulation has as its object the gestures produced to create the cultural artifact (see Freedberg and Gallese 2007; Gallese 2011, 2012, 2017; Gallese and Guerra 2019).

This hypothesis has been corroborated and confirmed by a series of studies carried out by our research group. For example, we demonstrated that the observation of letters of the Roman alphabet, Chinese ideograms or meaningless scribbles, all written by hand, activates the beholders' cortical motor map of their hand (Heiman, Umiltà and Gallese 2013).

In two other studies, we demonstrated that a similar motor simulation of hand gestures is evoked when looking at the cuts on canvas by Lucio Fontana (Umiltà et al. 2012), or at the dynamic brushstrokes on canvas by Franz Kline (Sbriscia-Fioretti et al. 2013). The visible traces of the creative gestures activate in the observer the specific cortical motor areas controlling the execution of the same gestures. Beholders' eyes catch not only information about the shape, direction and texture of the cuts or strokes; by means of embodied simulation they breach into the actual motor expression of the artist when creating the artwork. The sensorimotor component of image perception, together with the jointly-evoked sensory and emotional reactions, allow beholders to feel the artwork in an embodied manner (Gallese, 2017, 2018b).

When looking at works of art what we see is not just the simple "visual" recording in our brain of what stands in front of our eyes, but the result of a complex construction, whose outcome is the result of the fundamental contribution of our body with its motor potentialities, our senses and emotions, our imagination, and our memories. The outdated concept of "purely visual" vision should give way to a novel model of visual perception: vision is a complex experience, intrinsically synesthetic, that is, made of attributes that largely exceed the mere transposition in visual coordinates of what we experience any time we lay our eyes on something. The expression "laying the eyes" indeed betrays the haptic quality of vision: our eyes are not just optical instruments, but are also a "hand" touching and exploring the visible, turning it into something *seen by someone* (Gallese, 2018b: 77).

Contemporary mainstream empirical aesthetics commonly distinguishes between the bodily quality of our engagement with works of art and the more detached, almost bodiless explicit formulation of aesthetic judgment. Actually, according to common wisdom, these aspects of aesthetic experience are kept separated: the power of works of art to engage beholders and their intrinsic and supposedly objective beauty, apparently rest on different mechanisms, where the aesthetic judgment of beauty would mainly rely upon detached forms of cognitive appraisal. We recently wanted to challenge empirically this widely held conviction, by exploring whether beholders' sensorimotor engagement with the emotional content of works of art contributes to the formation of their objective aesthetic judgment of beauty (Ardizzi et al. 2018).

To this purpose, participants' sensorimotor engagement was modulated by asking them to overtly contract the Corrugator Supercilii facial muscles or to refrain from any voluntary facial movement, while judging the aesthetic value of painful and neutral facial expressions in selected examples of Renaissance and Baroque paintings. Results demonstrated a specific increase in the explicit rating of aesthetic beauty of paintings showing painful facial expressions during the congruent activation of the Corrugator Supercilii muscles. The same manipulation of participants' facial expression did not affect their aesthetic judgment of beauty of painted neutral facial expressions. Furthermore, participants' empathetic traits and expertise in art were found to correlate directly with the amplitude of the motor enactment effect on their aesthetic judgments (Ardizzi et al. 2018).

These results suggest that the mimetic stance towards the beholden images not only affects the empathic engagement they evoke, but also the explicit aesthetic judgment of their artistic beauty. As we wrote in this research article, "The present results demonstrate for the first time that beholders' sensorimotor engagement with the bodily-based painful experiences portrayed in works of art represents a consistent bottom-up mechanism that significantly plays a role in the formation of an objective aesthetic evaluation of beauty and that interacts with top-down factors (i.e., expertise in art, empathetic traits). Despite the emphasis of the original empathy theorists on the role played in aesthetic evaluation by bodily based resonance with the artwork, the neuroaesthetic tradition seems to have mainly inherited the "Kantian" view of the aesthetic stance, that is, a detached state in which the experience of beauty is separated from beholders' bodily involvement. Indeed, sensorimotor mechanisms are not comprised in the major models of aesthetic appreciation. […]. The present results reveal the necessity of extending the role of sensorimotor engagement beyond the domain of artist's gestures to the implicit resonance of such engagement with the emotional content of works of art." (Ardizzi et al. 2018: 8). As this evidence suggests, the body might play a role also in the apparently detached and disembodied explicit aesthetic appraisal of cultural artifacts, opening a new interesting line of research.

Aesthetic Experience as a Mediated Form of Intersubjectivity: Embodied Simulation and Film

What does film immersion consist of? How do we engage with the characters moving on the screen, and how do we empathize with their stories? We decided to address these questions experimentally, by focusing on two aspects of film style: camera movements and montage. As David Bordwell wrote, camera movements are a "persuasive surrogate for our subjective movement through an objective space." (Bordwell 1977: 23). We performed a first combined behavioral and high-density electroencephalography (EEG) study, investigating spectators' motor cortex activation during the observation of videos showing an actor performing hand actions, like grasping an object placed on a table (Heimann et al. 2014). The camera filmed the scene in four different ways: still, zooming in on the scene, approaching the scene by means of a dolly, that is, moving along tracks, and approaching the scene by means of a steadicam, a camera secured to the body of a moving camera man so to minimize vibrations and oscillations. The results showed significantly stronger motor activation of spectators' brain during the observation of videos filmed with the steadicam. The EEG results were paralleled by the behavioral ones: when asked about how they experienced the different videos, participants judged those filmed with the steadicam as those most resembling the visual experience of approaching the scene by walking towards it.

The results of Heimann et al., (2014), however, raised further questions regarding the precise nature of the motor simulation involved. The first possibility was that the steadicam added

ecological validity to the presentations, leading to stronger activation of the mirror mechanism in response to the observation of the hand actions executed by the actor filmed in the scene. Alternatively, the simulation of the movement of the camera man walking towards the scene while filming it might have generated a genuine simulation of walking in the spectators' brains. In order to clarify this issue, we carried out another experiment where we filmed an empty room with still camera, zoom and steadicam. Results showed stronger activation of spectators' motor cortex during observation of videos filmed with the steadicam, thus demonstrating for the first time that filmic means such as camera movements *alone* can modulate spectators' motor bodily engagement with film (Heimann et al., 2019).

Another important element of film style is editing: thanks to editing we are able to immerse in the film's narrative fiction, happily unaware of the artificiality of what we are seeing. Every film is a concatenation of images, and for the most part they are linked together by continuity editing, which permits the conjunction of frames and sequences that can be very different in their visual contents. Despite the fact that the perception of the flow is created by a succession of discontinuous images, the editing guarantees space-temporal and causal unity between the sequences (Gallese and Guerra 2019).

Various empirical studies have shown that during the viewing of a film, blinking and saccadic eye movements tend to take place when the viewer's attention is at a low ebb, such as during the interruption between two events. If the editing cut happens at this point, the viewer notices it less. The efficacy of the continuity editing technique depends greatly on the typology of the images prior to and following the cut. The masking of the cut is successful when the sequence immediately following it is congruent with the expectations generated by the sequence which preceded the cut. One of the rules that governs continuous editing is closely related to the relationship between the predictive anticipation of what we will see and the continuous perception of the narrated events: this rule, which concerns the position of the camera vis-à-vis the actors being filmed, is called the "180° rule"; it provides that the space in which the action is being filmed is divided in two by an imaginary line, the axis. The camera is placed in one half, while the other half is the so-called "pro-filmic space" in which the action is filmed.

Previous studies have shown that editing adhering to the 180° rule does not generate a sensation of discontinuity, while those that violate the rule do. We investigated how the brain of spectators responds to sequences respecting or violating the 180° rule: although both conditions show perceptual discontinuities between the frames shot before and after the cut (given that the camera was moved), only the frames edited crossing the line arouse the viewer's notice. According to our hypothesis, this cannot entirely depend upon purely visual-attentional effects. One of the consequences of crossing the line is that the frame shot before the cut is completely inverted and specular in the second frame: what was on the right before the cut, after the cut is on the left and vice versa. The viewer has the sensation that his perspective has been inverted. Therefore, the second frame, which violates the 180° rule, according to our hypothesis, is not only profoundly disturbing from a perceptual point of view, but is also characterized by sensory-motor incongruence. The perceptual dissonance the viewer experiences while watching a scene edited crossing the line is caused by the violation of sensory-motor expectations generated by experience of corporeal interaction and the way things happen in the real world.

We used high density EEG to record the neural basis of perception of the two types of editing (continuous and discontinuous editing). Cuts and edits in general elicited early brain responses, indicating the registration of syntactic violations, as known from language, music, and action processing. However, continuity and discontinuity edits differed from each other regarding later

brain responses, likely indicating the differences in spatial remapping as well as in the degree of conscious awareness of spectators' perception. Our results show that the perceptual analysis of sequences assembled with discontinuity editing does not depend on visual attention, but on how much these sequences deviate from our visual perception in real life, as the perspective from which we normally view the world is disoriented (Heimann et al. 2017). Film editing stimulates the perceptual competences and the underlying neural mechanisms that are used in our visual interaction with the world around us: editing engages spectators' embodied visual perception that uses their previous sensory-motor experiences from the real world to map, revise and detect the discontinuities of the moving images in film (Heimann et al. 2016; see also Gallese and Guerra, 2019).

As when beholding paintings, film experience and film immersion do not depend just on concepts and propositions, but rely on sensorimotor schemas, which get the viewer literally in touch with the screen, shaping a multimodal form of simulation, which exploits all the potentialities of our brain-body.

The evidence reviewed so far on visual arts and film highlights the embodied sensorimotor quality of aesthetic experience. It also suggests that the re-enactment of what is being contemplated might affect the explicit formulation of the aesthetic judgment of beauty of the beheld works of art. In the last part of the chapter, I speculate on the role played by embodiment in the origin of human meaning-making and the invention of cultural artifacts.

Habits, Practice and the Genesis of Symbol-Making

> "Social agents are endowed with habitus, inscribed in their bodies by past experiences. These systems of schemes of perception, appreciation and action enable them to perform acts of practical knowledge, based on the identification and recognition of conditional, conventional stimuli to which they are predisposed to react" (Bourdieu 2000: 138).

What I said so far, mostly dealt with the receptive side of aesthetics. I concisely reviewed empirical results from our lab shedding new light on the neurobiological mechanisms underpinning the experience of man-made objects, like still and moving images, making brief reference also to fictional narrative, for which I have no room here. The main point I wanted to make is that prosaic reality and the parallel world of fiction share a great deal in terms of the way they are experienced, and suggested how this might happen in light of the results of empirical aesthetics.

This perspective, however, falls short of addressing the creative aspect of meaning-making and aesthetics. At a certain time in evolution something unprecedented happened. Utilitarian behavior led to the production of material symbols. The movements and skilled actions that for hundreds of thousands of years enabled the ever more skilled and refined making of tools and weapons, the killing of animals, and the building of shelters and huts, started to be employed also to create objects of a totally different kind: material objects whose main purpose was to serve the new function to tell/represent something to someone else. The already elaborated and complex rules guiding individuals' behavior within their social group – abilities that likely were quite sophisticated, no less sophisticated than the social skills exhibited by present non-human primates – were reshaped in novel ways by the newly emerged cognitive technology of symbol-making.

Many scholars nowadays endorse the so-called 'bio-cultural paradigm', maintaining that any human technology is at the same time the expression of the human mind and of human bodily

nature, as the latter scaffolds the former. Many scholars are indeed questioning the rigid dichotomy separating culture from nature, arguing that culture – conceived as extension or outgrowth of the natural – is the evolved capacity of human beings to develop and use instrumental intelligence (Gallese 2019). Culture can be described as a naturally evolved type of human cognitive technology. As argued by the French philosopher Gilbert Simondon (2001), technology exceeds any narrow utilitarian purpose: as technology develops and expands, it produces new relations between people and things, between people and people, and between things and things. According to Simondon – and rightly so – technology is a network of relations: far from marking our alienation from the natural world, technology is what mediates between humankind and nature. This point has been recently reinstated by the cognitive archeologist Ian Hodder (2012) with the notion of 'entanglement', that is, the different ways humans and things relate to one another.

According to the archeologist Lambros Malafouris, we need to "reclaim the study of mind and its evolution from the detrimental influences of 'cognitivism', evolutionary psychology, and neo-Darwinism", arguing for "a continuity of action between brain, body, and culture and the primacy of material engagement" (Malafouris 2015: 352; see also Malafouris 2013). Moreover, continues Malafouris, "the relation between brains, bodies, and things (in the broad sense of the relevant material environment, natural or artificial) is not one of representation, not even one of mere interaction. Instead, it is a transactional process of mutual constitution. It is only by understanding the different forms and properties of this transactional co-constitution that we will ever be able to understand the remarkable plasticity of the human mind." (Malafouris 2015: 354).

How did the new cognitive ability of symbol-making emerge in the first place? One could be tempted to speculate that symbol-making be the externalization of preexisting symbolic thought. I want to challenge this assumption by positing that symbolic thought and symbol-making are not only intertwined, but they co-determine one-another, once behavior is turned into habits and mere action gives way to practice. I recently proposed that human cultural evolution can be conceived as a perpetually dynamic process of cognitive technological development, where hand-axes, the first prehistoric lithic tools, and the iPhone 7 used to shoot feature movies represent two different and temporally distinct expressions of the same technological dimension (see Gallese, 2019). What we currently designate as 'cultural artifacts' or 'works of art' constitute no exception to this perspective.

A neurobiologically plausible and empirically-sound minimalist account of the origin of symbol-making can greatly benefit of the notions of habit and practice, as proposed, among others, by Pragmatists, Pierre Bourdieu and practice theory. I have neither the ambition and competence to address these issues in a systematic way, nor enough space to provide a thorough review and criticism of these different theoretical proposals. In the present chapter, I will confine myself to the use of some of these concepts and ideas as potentially useful building blocks of a neuroscientific hypothesis on symbol-making.

What are habits? The opening sentence of John Dewey's seminal book *Human Nature and Conduct* (Dewey, 1983: 15) reads: "Habits may be profitably compared to physiological functions, like breathing, digesting. The latter are, to be sure, involuntary, while habits are acquired." Six years earlier, William James wrote: "99%, or, possibly, 99.9% of our activity is purely automatic and habitual, from our rising in the morning to our lying down each night. Our dressing and undressing, our eating and drinking, our greetings and partings…even most of the forms of our common speech, are things of a type so fixed by repetition as almost to be classed as reflex actions" (James, 1916/1983: 48).

The processual and physiological characterization of habits betrays the Pragmatist account of action as process. Pragmatism considers humans as creatures of habits, where habits are conceived as vehicles of cognition (Määttänen, 2010). The notion of habit, however, has many facets. Analytic philosophy shied away from habits, considered as mindless and dull repetitions of behavioral routines (see Fodor 2008). Fodor's critique echoes much older criticisms, as those raised by Kant who considered the notion of habit objectable. Both Kant and Fodor, likely considered habits - as proposed by Hume (1739-40/1985), as a sort of behavioral conditioning, where behavior repetition occurs without any deliberate conscious act of will, as a self-propelling activity performed without reflection, let alone cognition (see Kilpinen 2015).

On the contrary, as recently pointed out by Kilpinen (2015), the position of Dewey and other classic Pragmatists is that intentionality without habituality is empty, but habituality without intentionality is blind. This implies that habits likely give rise to symbolic expression and produce meaning through 'would-acts' (Peirce 1992–1998, vol. 2: 402), namely, through dispositional potentialities that are *both* bodily and mental. The emphasis here is more on disposition than on repetition as the trademark of habit. I'll come back later to the role played by repetition in the genesis of habits. For the time being, I want to underline the fact that the definition of 'habits-as-dispositions' in my opinion can be connected to the notion of motor potentiality. Our brain/body expresses the range of potential relations to the world that lead to the constitution of a relational self, shaping and delimiting the horizon of the world we inhabit. We come to know and understand our world, our *Umwelt*, in virtue of the relational potentialities instantiated by our body (Gallese 2009; Gallese and Sinigaglia 2010).

But how are bodily motor potentialities or dispositions turned into the production of symbolic objects? Is it really true that repetition and ritualization play no role in shaping the symbol-making practice? Pierre Bourdieu and practice theory might help us to shed light on this unresolved mystery. As proposed by Bourdieu, "The theory of practice as practice insists, contrary to positivist materialism, that the objects of knowledge are constructed, not passively recorded, and, contrary to intellectualist idealism, that the principle of this construction is the system of structured, structuring dispositions, the habitus, which is constituted in practice and is always oriented towards practical functions" (1992: 52). According to Bourdieu's model, practices are acquired through mimesis.

From this preliminary and sketchy account, it should be already clear why this approach might look promising to build an embodied neurobiological theory of symbol-making: practice theory, although in a non-systematic way (see Reckwitz 2002; Scheer 2012), aims to overcome the dichotomies of subject/object, mind/body and individual/society. In practice theory, "subjects or agents are not viewed as prior to practices, but rather as the product of them; subjects exist only within the execution of social practices. […] The individual subject in practice theory is not conceivable without the body. […] The materiality of the body provides not only the locus of the competence, dispositions and behavioral routines of practice, it is also the 'stuff' with and on which practices work. The body is actor and instrument" (Scheer 2012: 200-201). Habit (or *habitus* as spelled out by Bourdieu) consists of schemas of perception, thought, and action producing individual and collective practices, which in turn reproduce the generative schemas (see Scheer 2012). It is the body with its motor potentialities that constrains, limits and dictates the range of possible practices.

The body determines social practices, but at the same time it is shaped by them. It is within the reciprocity of body and social practices that cultural artifacts are created. Thus, symbol-making and the ensuing cultural practices and institutions emerge from implicit knowledge, the complex

set of behavioral paradigms that individuals simulate and mimetically internalize, because of the constant interpersonal relations they entertain within the dense network of social exchanges they are enmeshed with since birth (Gallese 2017b). Cultural practices "adhere to a learned repertoire that positions a person in a social field and constitutes participation in that field's game" (Scheer 2012, 202).

The late British anthropologist Alfred Gell, in his posthumous *Art and Agency* (1998), fully endorsed a Pragmatism-inspired account of works of art, sidestepping their supposed beauty or meaning, focusing instead on their being agents endowed with delegated intentionality, which exerts an impact on the world. For Gell, following Peirce, cultural artifacts and what we now designate as works of art are indexes, that is, agents endowed with intentionality that evokes an *abduction of inference*, a form of conjectural inference moving from consequences to causes, thus enabling to appreciate the intentionality that led to their construction. Something similar, I should add, to what happens in our brain when beholding Lucio Fontana's cuts on canvas, where the consequences of the artist's action – the cuts – lead to the simulation of their causes, the hand gesture producing them (Umiltà et al. 2012). According to this perspective, art before being a system of symbols is an action system: cultural artifacts exert agency on the world. Art is viewed as "a system intended to change the world rather than encode symbolic propositions about it'. […] Visual art objects are not a part of language ... nor do they constitute an alternative language." (Gell 1998: 6).

The creative gesture that imbues material objects with meanings transcending their immediate utilitarian affordances, might well be the outcome of the serendipitous discovery of a single individual, later on shared as social practice by the other members of the social group. Let's consider one of the earliest historical record of human symbolic activity: the mysterious hand-made geometric engravings covering the surface of little blocks of ochre, discovered in the Blombos cave near Cape Town, likely dating around 70.000 BP (Henshilwood et al. 2002; d'Errico et al. 2003).

When looking at these fascinating objects, I can't refrain from speculating that they could be considered as the late 'translation' of some individual's serendipitous empirical observation that when cutting something over a rigid surface, the cutting activity leaves a permanent trace on it, thus revealing that a given practice can persist as a material sign that stands for it, even when the practice is over and its agent long gone. Such 'discovery' might have been favored by the constant exposure to the systematic experienced relationship holding between animal tracks and the absent animals. The deer track stands for the deer in spite of its not being present. However, this observation might have not been sufficient to lead to the intentional making of symbolic objects. I submit that to accomplish that one needs something more, namely the possibility to internalize the causal relationship between action and sign through its actualization by means of one's own bodily action.

I am fully aware that this is nothing but a "just-so story", but I think that it also might constitute a plausible starting point for a minimalist embodied neurobiological hypothesis on the origin and evolution of symbol-making. The suggested gradual transition from tool-making to symbol-making, grants the following: 1) It shows that utilitarian and symbolic behavior are both chapters of the same cognitive technology trajectory; 2) It doesn't require one to assume that symbol-making is the late externalization of a previously existing inner symbolic thought, because it suggests that symbolic thought and symbol-making are the co-constructive outcome of the development of shared performative practices and habits; 3) It is fully compatible with the neurobiological characterization of human relational potentialities as instantiated by embodied simulation.

A further element that might have contributed to the diffusion and consolidation of symbol-making practices and the production of symbolic objects is repetition and its formalization into ritual behavior. Repetition is a very efficient mean to learn something new: when learning a new skill, it is common practice to mimetically repeat the instructor's displayed behavior, until the gap between what has to be learned and what is reenacted narrows down and eventually disappears. Ritualization transforms behaviors initially repeated for mere learning purposes into a set of practices that provides greater social cohesion and sense of communal belonging to its practitioners.

Ritualization, as understood by zoology, refers to the evolutionary process by which animal actions or behaviors loose the original function but are retained for their role in display or other forms of social interaction. The ritualization of utilitarian behaviors, like manufacturing tools and using them for survival purposes might have sparked the creation, development and evolution of what today we designate – broadly speaking – as cultural artifacts. A ritual is "a stereotyped sequence of activities involving gestures, words, and objects" (Turner 1973: 1100). As proposed by the late Catherine Bell, "The implicit dynamic and 'end' of ritualization – that which it does not see itself doing – can be said to be the production of a 'ritualized body.' A ritualized body is a body invested with a 'sense' of ritual." (2009: 98). Furthermore, "Since ritual acknowledges powers beyond the invention of the community and implies correct and incorrect relations with these powers, it is often more likely to generate a social consensus about things. […] Activities that are so physical, aesthetic, and established appear to play a particularly powerful role in shaping human sensibility and imagination." (2009: 137).

The ritualization of shared social practices affects and colonizes the life style and the imaginary world of a given social community. Shortly, my hypothesis is that through the repetition, combination and memorization of particular shared behaviors and actions, and their mimetic ritualization, the social group infuses new cultural meanings into reused bodily performances. This hypothesis is close to the 'instrumentalist' perspective offered by John Dewey in *Experience and Nature*, where he wrote: "The invention and use of tools have played a large part in consolidating meanings, because a tool is a thing used as means to consequences, instead of being taken directly and physically. It is intrinsically relational, anticipatory, predictive. Without reference to the absent, or transcendence nothing is a tool." (1929: 185).

The performative character of the body and the reuse of its underpinning neural mechanisms constitute the backbone of the evolution of human cognitive technologies. Indeed, the performative character of the body enables the 'discovery' that the world affords the extension and externalization of cognition, and links this discovery to the invention of symbolic objects.

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