With the development of computer and cognitive sciences, it has been made possible to create artifacts capable of simulating cognitive skills (perception, attention, decision, invention and even emotion), behaviors that tend toward autonomy and interactions with the milieu, until now specific to human race. It is as if, by an unexpected inflection of evolution, the externalization of our cognitive skills into these artifacts had given birth, without our knowing it, to a new species—or, more precisely, to a cospecies.

In this regard, as long as artists—and particularly those in the performing arts—make use of such technologies, it is a matter of understanding what has been changed or what will live on in artistic creation within both the effects of presence caused by these artifacts, in the aesthetics experience and its subjective shift, and even beyond through the company of these new beings, in our very conception of humanism.

Artists in the performing and theatrical arts currently have access to technology of an unprecedented variety and complexity in comparison to classic methods. This allows artists, without necessarily dismissing traditions, to familiarize themselves with robots, avatars, virtual characters and other “intelligent agents.” As diverse as they are, these technologies use computer models inspired from life and intelligence.

Current technologies available to artists are of unprecedented complexity and variety compared with conventional techniques. They have enabled creators, in particular those in the performing arts, to familiarize themselves with robots, avatars, virtual characters and other “intelligent agents.” As diverse as they are, these technologies use computer models inspired from life and intelligence.

FROM THE AUTOMATON TO THE TECHNOLOGICAL BEING

In the first part of this investigation, I focus on examining the technical and functional principles of these technologies. As diverse as they are in their structures and functions, these artifacts share the use of computer models that simulate life and intelligence, although at differing levels of perfection. Computer technology has profoundly revolutionized the larger world of technology. It has introduced the abstract language of programming into processes that were essentially material or energetic (mechanics, electrics, electronics). All computers are a hybrid of various circuits, processors, memory, sensors, actuators and algorithms expressed in the form of a symbolic code that can be executed by a machine, directly inspired by the theories and models of science. In the first years of computer technology (computer science), computing essentially involved mathematics, logic, physics, optics and the computer technologies themselves that provided these models. But with the appearance of the cognitive sciences—a vast interdisciplinary group bringing together information science, psychology, neuroscience, the theory of evolution, robotics, linguistics and different sectors of philosophy and social sciences—computers have become progressively able to simulate certain abilities characteristic of living, intelligent creatures and their evolution, as well as all artificial information systems.

Until the appearance of computers, the advancement of machines was measured by their degree of automatism. The more elements a machine possessed that could perform tasks without human intervention, the more it was considered to be technically superior to others. Although sometimes highly complex, the tasks these machines performed were entirely repetitive. This was clearly noted by Gilbert Simondon: “Au-
Autonomy

Although the first computers were defined as machines capable of automatically processing information, we did not limit ourselves to asking them to automate certain sometimes highly complex tasks. We also entrusted them with the ambitious mission of simulating the very thought processes of humans, our ability to reason, our intelligence. This became a special field within computer technology: artificial intelligence. The radical hypothesis that forms the basis of this research, originally formulated by Alan Turing [3], rests on the idea that thought can be reduced to calculations and the manipulation of symbols. “Thinking is calculating.” In this first conception of artificial intelligence [4], the results were only partially satisfactory. Many problems remained unresolved.

Then, instead of simulating intelligence with logical-mathematical processes, we began to try to discover how the human brain acquired this intelligence over the course of its ontogenesis and how the body contributed to the emergence and development of a different way of thinking. Virtual artifacts simulated by computer were equipped with methods of perception, action and coordination of actions and perceptions, so that they could react and adapt to unforeseeable modifications to their environment. Thanks to these algorithms, computers became capable of autoprogramming themselves and acquired a certain autonomy. That is to say, if we return to the etymology of the term [5], they were able to establish their own rules and have a relative amount of freedom within a limited and very specific frame of action. These algorithms, combined with the progress of the machines, were and are for the most part the results of the cognitive sciences [6]. They allow machines to perform operations that were simply not possible with the classic determinist programs. I will cite a recent example: the development by Google of an algorithm that learns to play online videogames like Space Invaders without the programmers having previously imparted the rules of these games. Consequently it functions as well as a human would under the same conditions. However, it cannot be anything more than a good player. Its abilities do not extend any further.

The autonomy of a system can only be relative. Even humans are only partially autonomous to the extent that we are subject to different pressures: physical environment, genetic inheritance, social constraints, etc. Moreover, many of our functions, particularly our vital functions, are (fortunately) regulated by powerful involuntary and unconscious automatisms as well as many of our mental processes and behaviors. Man is a highly evolved natural composite of automatism and autonomy. Thus, it is possible to program virtual beings or beings assembled out of concrete materials, most often anthropomorphic, with cognitive abilities that approach those of humans: a multimodal perception of the world, learning through trial and error, recognizing artificial or natural shapes (such as faces), the development of an associative memory, decision-making followed by action, intentionality, inventiveness, the creation of new information, the simulation of emotions and empathy, and social behavior.

Avatars

Artificial humans fall into two broad categories: virtual humans and robots. While the two share many basic technical principles, these artifacts have distinct modes of existence and different degrees of autonomy. Virtual humans, also known as avatars, do not possess material form. They are projections of images. They exist as representations of humans, in virtual form, within a virtual space, such as cyberspace or virtual and augmented reality systems. However, in cyberspaces like Second Life (in its first and second versions) or online video games, avatars are not always faithful representations of the player but are often imagined representations that allow the player to appear in disguise, under another identity, even as another sex, and play a role incognito. The avatar can also take the form of an animal or a purely imaginary being.

The simplest of these beings—which possess zero-level autonomy but are not automatons—are capable of reproducing their controllers’ movements and gestures in real time. The avatar is the user’s double, simultaneously augmented and reduced—augmented in the sense that it can achieve impossible actions in the virtual world (flying, walking on water, becoming invisible) and reduced in the sense that it is only a very incomplete simulation of its user. These avatars can also be directed by their users, but then their movements no longer correspond exactly to what the user does. They are comparable to puppets the puppeteer guides with strings. The movements of the puppet do not correspond to the movements of the puppeteer’s hand. However, this difference does not necessarily confer autonomy [7].

Autonomy in avatars appears in the category of “autonomous actors,” which are endowed with behaviors that allow them to act in a relatively autonomous way in order to accomplish their tasks. They see, hear, touch and move by means of sensors and virtual actuators. Daniel Thalmann, a specialist in virtual humans, affirms they can even play tennis by basing their play on that of their adversary. Thus, after interpreting information from their environment, they can make decisions and act accordingly.

At a more advanced level of autonomy, there are actors that possess a representation of the world that surrounds them—objects, other synthesized actors, avatars representing humans—and that are able to communicate with that world. Virtual universes are far more credible when they are inhabited by autonomous avatars. This communication brings into play a capacity to interpret and use a nonverbal language based on the specific postures of a body expressing
an emotional state. Nonverbal communication is essential in order to direct interactions between synthetic beings; it is an expression of the body’s thought.

**ROBOTS**

Artificial humans classified as robots are material artifacts; they have bodies that can be seen and touched, and they act on real objects. The term *robot* was coined by a playwright at the beginning of the 1920s and designated humans that were artificial but organic in constitution [8]. Subsequently, it was largely used to designate mechanical humans on nonhumanoid artifacts capable of replacing humans in certain tasks. An extension of a mythic quest that extends far into the past, robots appear in modern culture as man’s double under two opposing aspects: threatening (for example, robots stealing work from humans) or benign (e.g., as friends to children and the disabled). The robot distills all our fears and hopes when we are faced with poorly socialized or misunderstood advances in technology.

At the level of zero autonomy, we find robots whose functions are strictly repetitive: for example, painting robots in the automotive industry or cleaning robots. At a higher level, we find machines, usually humanoid or animal in shape, endowed with an element of autonomy. The difference between autonomous robots themselves is essentially in two interrelated parameters: their level of autonomy and their field of action. There are no universal robots whose autonomy allows them to solve any task, and we are not ready for such robots (incidentally we ourselves are not skilled at solving any task). Nevertheless, certain robotics researchers believe that a form of consciousness could be simulated in robots and facilitate the emergence of a very high level of intentionality and decisional autonomy. The programming of such artifacts is often inspired by algorithms that have emerged from artificial intelligence and the theory of evolution and that are used in the creation of virtual humans.

Endowing robots with a level of autonomy that approaches that of humans in their actions and in their relationships with other intelligent entities requires that they be instilled with similar cognitive abilities (reasoning, evaluation, decision-making, adapting actions to the situation, formulating a strategy that takes into account past, present and future experiences, etc.). These robots would also have to be capable of expressing emotions (although it would not be necessary for them to actually feel the emotions) and even empathy (currently the subject of specialized research), if they are to evolve with other intelligent entities.

There is an intermediate category between robot and human—the *cyborg* “a human being,” according to Anais Bernard and Bernard Andrieu, who has received mechanical or biological grafts, blending digital, logistical and robotic technology. Exoskeletons and prostheses make the individual’s body a locus of hybridization and transformation, with the aim of recreating new perceptions of his environment through a modification of the notions of space and time [9].

These grafts, which are usually utilitarian in nature, can become the objects of aesthetic experiences, like Stelarc’s *Third Hand* (1980), which gave users the chance to use electrical discharges to stimulate an electronic hand grafted into the forearm of the artist.

**A HUMAN COSPECIES**

According to the International Federation of Robotics, in 2013, approximately 4 million personal-use robots were sold worldwide, and 31 million more were to be sold between 2014 and 2017. Although it is impossible to predict the specific uses for which they will be designed, we can expect that they will be principally intended to entirely or partially replace humans in dangerous or difficult situations, or in hostile locations (military and nuclear applications are the subject of considerable attention). They will assist the disabled (robotic devices may even be piloted by thought, as certain prototypes already are); they will rescue, diagnose and treat accident victims; and they will be intelligent, empathetic and sympathetic companions to the elderly and children. The applications are innumerable, and some are already functioning with some success at this very moment. Everything is occurring as if humans, consciously or unconsciously, by externalizing the cognitive abilities that are unique to them, as they did with the tool, as well as with their emotional and empathetic faculties, were in the process of bringing into the world a new, very closely related human species, a sort of human cospieces [10]. If at present none of these artificial beings succeeds at being indistinguishable from humans, the tendency is to move closer and closer to this model. Some researchers, such as philosopher Gérard Chazal [11] or evolutionary biologist Richard Dawkins, to name only a few, even foresee that in a not-improbable future, computers will acquire *self-awareness*. The technology that underlies these artifacts no longer merely constitutes a space for man; it is creating the conditions for contact with quasi-living artificial beings. From an evolutionary standpoint, we have provoked an unexpected change in the direction of natural evolution and substituted the voluntary choices of science, with all its utopian possibilities and risks, for the laws of natural selection, driven partly by chance. Evolution never stops.

**THE NATURAL HUMAN/ARTIFICIAL HUMAN AESTHETIC RELATIONSHIP**

It is from among this new and growing race of artificial humans that resemble us more and more that artists from the performing arts and the theater recruit, not zealous servants, but partners and accomplices. Historically, the use of artificial humans in these arts has been inscribed within the movement to de-specify art along with the movement of de-definition [12] of art (led by Harold Rosenberg) that began with the end of traditional techniques practiced in the fine arts. Henceforth, all techniques can be used for artistic ends. However, while de-specification spread the field of creation across an unlimited area of possibilities at the risk of its own disappearance, the introduction of the digital technologies
inherent in artificial humans has tended to reunite the field in a specific and fairly coherent and structured whole, despite the variety of elements that make it up.

The aesthetic approach to relationships between natural humans and artificial humans profoundly changes the nature of these relationships. They are no longer evaluated in terms of the power and speed of calculations, of efficiency in communicating, of tasks to be accomplished, but in terms of pleasure, a pleasure unique to the aesthetic experience—a pleasure accompanied by a large palette of emotions, feelings, moods and thoughts. Consequently the debate, for example, surrounding the theory of the Uncanny Valley—which suggests that the more a robot resembles a human without succeeding completely, the less empathy we feel for it—no longer has a foundation, because the imperfections of such a robot may be voluntarily created by its maker not in order to provoke discomfort in the audience but to incite aesthetic pleasure. Art’s paradox is to transform ugliness into beauty.

Avatars and robots have their own aesthetic. When we observe these artifacts in action, our cognitive attention focuses on the forms (physical forms, but also attitudes, gestures and eventually expression of emotions) that reveal, or seem to reveal, their autonomy. We watch for the slightest hint that confirms or disproves that they share something with us. We live a singular aesthetic experience that makes us feel confirmed or disproved that they share something with us. Autonomy and empathy are related. Indications of autonomy in an artificial human stimulate the empathy of human observers and lead them to mentally project themselves in place of the artifact.

**EMPATHY AND COPRESENCE**

Empathy is a mental and physical state that simulates the subjectivity of another; it is the capacity to put oneself in another’s place while keeping one’s own identity [13], according to therapist Jean Decety. Empathy comprises two fundamental components. The first is an emotional and sensorimotor resonance that is automatically triggered, uncontrollable and unintentional. We only understand another’s gestures and emotions to the extent that we mentally simulate them in a sort of “shared body state,” a neural mechanism called “unmediated resonance” [14], shared by the observer and the observed. The second component is a controlled and intentional taking of another’s subjective perspective. I will add a third component to empathy: temporal resonance. Empathy also makes us share the moment of another; it plunges us into the same temporal flux. It makes us copresent with the other. Reciprocally, we feel a being as another if we are able to enter into sensorimotor, emotional, subjective and temporal resonance with them.

According to psychotherapist Daniel Stern,

“The mind is always incarnated in a person’s sensorimotor activity. It is interwoven with the immediate physical environment that co-creates it. It is constructed through its interactions with other minds. It draws and maintains its shape and its nature from this open exchange. It emerges and exists only because of its continual interaction with intrinsic cerebral processes, with the environment, and thus other minds [15].”

For each one of us, a community of spirits brought together in an “intersubjective matrix” is the source of our mental life and gives our minds their current shape [16].

Paradoxically, we can also feel empathy for an object—a piece of architecture, a painting—under certain conditions. The philosopher Adam Smith was the first to talk about empathy in regard to theater (though he did not use the word empathy, which did not exist in his era, but the closely related word sympathy) [17]. For him, in order for the spectators of a play to understand the actions of the characters, they must identify with the actor, project themselves on him and adopt his point of view, while from the other side, the actor must identify with the spectators in order to feel their reactions and emotions. Here Adam Smith perceived the double communication—we would say an intersubjective communication—that determines a good reception of the meaning of a play. The idea of empathy would largely inspire the aesthetic of the end of the nineteenth century. Theodor Lipps renamed empathy under the term *Einfühlung*. “All aesthetic pleasure,” he affirmed in *Ästhetik*, “is uniquely and simply founded on *Einfühlung*” [18]. “Aesthetic pleasure is the objectified pleasure of the self.” To enjoy something aesthetically is to make one’s perception an object of pleasure. The idea of empathy then underwent a certain level of disinterest, but it resurfaced a few years ago with the contribution of the cognitive sciences and the discovery of mirror neurons in particular. For neuroscientist Vittorio Gallese and art historian David Freedberg [19] as well as for neurobiologist Pierre Changeux [20], empathy is at the foundation of the aesthetic reception of works of art. Without stating that it is the sole foundation for this reception—aesthetic pleasure is generated through other neurological paths—I nevertheless believe that it constitutes the natural system (a phylogenetic inheritance) that determines the emergence of aesthetic pleasure in a subject [21].

**IMMERSION, MOTOR RESONANCE AND TEMPORAL RESONANCE**

The question is this: What changes will the presence of artificial humans endowed with autonomy provoke in aesthetic reception? I will first note that the large majority of artificial humans created for artistic ends are not really autonomous but—in this lies all the skill of their creators—give the illusion of being so. All that is necessary is a tiny detail in their behaviors, a seeming hesitation (in reality a controlled one), for the audience to believe, or want to believe, that the artificial human possesses some spark of life or intelligence. During a 20-minute performance [22], the Japanese artist Oriza Hirata placed two vaguely anthropomorphic cleaning robots complaining about their jobs alongside two humans on stage. The programming, which was highly difficult because of the precision necessary in the vocal and gestural dialogue, is
entirely automatic. The slightest gesture, the slightest silence, the slightest vocal nuance is preplanned. The robots possess no autonomy whatsoever. In this respect, they are no different from L’Écrivain, the marvelous little eighteenth-century automaton of Pierre and Henri-Louis Jaquet-Droz. Empathy is not suggested by the realism of the forms but by the realism of the gestures and behavior.

This type of realism creates the illusion of autonomy, of a nonmechanical life that holds surprises and the unexpected, that incites empathy, as the audience’s reactions demonstrated: The spectators laughed, cried and experienced the feeling that the robots were speaking and moving in a subjective way, Oriza observes. “What was very impressive,” he added,

was that the real robots were completely different from the robots that we see on screen, in films . . . through the robots I rediscovered the power of theatre: namely that someone is doing something right in front of me [23].

Through the empathy of the spectator toward the robots, this immersion in the same space with machines and this resonance with their temporality in effect creates in the spectator an impression of copresence within an unmediated intersubjective communication.

Moreover, if empathy is a motive and emotional resonance that spontaneously arises, it is also a way of accessing the subjectivity of another. It is itself modulated by the subjectivity of the individual who experiences it, his history, his memory and his culture. For example, I doubt that cultures that forbid pictorial representations are inclined to develop empathy for this type of representation. Japanese culture, in contrast, which attributes a principle of life to all objects, whether animate or inanimate, would tend to favor the adoption of these artifacts as it favored the culture of puppetry.

THE REALISM OF GESTURES

Many works play on the realism of gestures and behavior. It can be achieved at little cost through automatic techniques: The introduction of false randomness into the program or simply the imperfect play (in the sense of indecision, imprecision) of the mechanisms. I recall, for example, attending a performance featuring robots on stage in 1992, in Nagoya, Japan, created by the team of Rick Sayre and Chico MacMurtrie. It was during an international exposition [24] devoted to robots in which Michel Bret, Marie-Hélène Tramus and I had been invited to participate. The performance was entitled A Participatory Percussive Robotic Experience Leading to the Birth of the Triple Dripping Fetus. A wild percussive concert was executed by enormous metallic robots where the deafening pneumatic and electric noises of the actuating mechanisms mixed with the thunder of the percussion. The robots, controlled by computer, possessed no autonomy. However, the jolts among the electric mechanisms and a certain uncertainty in the sequence of movements gave the spectator the illusion that they were in the presence of quasi-autonomous creatures. I myself felt this impression quite intimately at a moment during a performance when an unforeseen event occurred. One of the robots lost a piece of his body, which landed at my feet. This incited a feeling of pity in me for this robot, who continued to move. His handicap made him human in my eyes. More recently, MacMurtrie introduced elements of artificial intelligence into the programming of his robots to make their actions smoother and more autonomous but still within the limits imposed by the scenario.

In truth, the autonomy of a synthetic actor—even if it is at a very high level—or of a human actor is necessarily limited, otherwise the meaning of the play collapses. Faced with this problem, Frank Bauchard believes that there are two ways of responding. Either the actor adapts to the constraints of the stage management and the machinery—a system—or he interacts with the machine by exchanging random information with it in a continuous loop.

“At that moment,” Bauchard says,

we have something that can no longer be fixed, but that is not totally unstable. . . . It is the direct, it is immediacy. More and more, the question today is how does the machine create the unpredictability on stage. I think that a robot introduces the unpredictable [25].

CREATING UNPREDICTABILITY

Jean Lambert-Wild and Jean-Luc Thereminarias, the directors of the 2001 production of the play Orgia, written in 1968 by Pier Paolo Pasolini (a “theatre of words,” according to the author), chose the second response: making the actor (in this case, a human) interact with the machinery—actually virtual beings whose images were projected on the screen. The actor was equipped with sensors that detected physical manifestations (heartbeat, skin conductivity and temperature, respiratory volume). This information, interpreted as emotional indicators by a computer, was processed in real time by a program (Dedalus) that allowed the actor to interact with these virtual beings, sort of imaginary marine organisms created from models of artificial life and endowed with unpredictable behavior. Over the course of the play, the emotions experienced by the actor acted via computer on the behavior of the organisms, and the actor reacted in turn to the behavior of these organisms. The actor’s presence was augmented by the presence of avatars, whose presence itself depended on the actor’s emotions, which were in their turn dependent on the emotions of the audience. In this particularly troubling immersive situation, several temporalities coexisted and intersected.

Another way of introducing unpredictability into the play of synthetic actors is to accentuate the effect of presence and implicate the spectators themselves in the dramatic action. This is what Bill Vorn and Louis-Philippe Demers, two Canadian artists, proposed in France [26] in their show Inferno, an inaugural event wherein robot arms were attached to the bodies of a few audience volunteers, transforming them into cyborgs in a matter of minutes. Over the course of the performance, which included several robots on stage, these spectators, while remaining free to act as they pleased, were subject to the pressures of the robot arms, which were programmed
and strictly controlled. Thus the spectators felt mechanical gestures on their bodies, full of intent, directly communicated to their sensorimotor systems. This provoked a real feeling of oppression and servitude, the goal of which, according to the authors, was to make the spectators realize that the cybernetic process can conceal a living hell. Once again we find ourselves in the paradoxical situation wherein the spectator feels (or can feel) an aesthetic pleasure by living an anxiety-inducing relationship.

The artistic form that authorizes a strong autonomy capable of adapting to a situation that was not foreseen by the programming seems to be controlled improvisation. It is with this view that Michel Bret and Marie-Hélène Tramus, with the collaboration of physiologist Alain Berthoz [27], created an autonomous virtual being with the appearance of a dancer. This dancer was endowed with a network of artificial neurons, a learning function and a body that followed the laws of human biomechanics. During the initial phase of creation, a real dancer wearing an exoskeleton that captured the movements of the articulations of her body taught the virtual dancer various dance steps, correcting her when she made an error. Once taught, the virtual dancer was linked to a real dancer equipped with motion capture technology. When the real dancer began to dance in front of the virtual dancer, the virtual being responded to her by improvising dance steps. These steps were not exactly those she had learned but the result of a compromise between those she had learned and those executed by the real dancer. Each improvisation, according to the offerings of the real dancer, gave rise to an unmediated nonverbal communication that translated as a "pas de deux" original.

The aesthetic reception of performances in which artificial humans are "engaged" shares fundamental traits with the aesthetic reception in traditional arts: the possession of a cognitive equipment inherited through our phylogenesis—empathy. A mental and physical state that results in emotional and sensorimotor reactions, even during the mistakenly termed "passive" contemplation of a work of art [28]. The body and cognition are never inactive in the aesthetic experience. In the traditional stage arts, this empathy, because it is exerted directly on the actors in the same space-time as the spectator, is much more intense, the impression of a more intimate copresence, the nonverbal communication that operates most effectively. We naturally feel we belong to the same intersubjective matrix as the actors. When artificial humans intervene in aesthetic reception, our tendency to seek in another experiences that have an echo in us pushes us to attribute qualities that are our own to these beings in a mirror effect and integrate them into this matrix. From this perspective, we have several reasons to view the performing arts as a privileged and experimental space, where, in the gratifying mode of aesthetic pleasure, natural humans mingle with, try to understand and welcome into their community these beings that look so much like them.

References and Notes

1 Gilbert Simondon, Du mode d'existence des objets techniques (Aubier, 1969) p. 11.
2 Simondon [1].
3 This idea was foreshadowed in the mid-seventeenth century by Thomas Hobbes, who considered thought (in the sense of reason) as a calculation composed of words maintaining logical relationships of inclusion and exclusion amongst themselves.
4 We do, however, owe some incontestable successes to the AI of this era in the fields of perception (artificial vision, recognition of acoustic signals and speech), reasoning (expert systems, decision-making aids, diagnostic aids, control aids, intelligent databases, digital games, etc.), language (automatic translation, analysis and word processing, indexing, classification, etc.) and action (planning, robotics, etc.).
5 It is constructed from terms borrowed from ancient Greek: auto (the self) and nomos (the law).
6 Other models, like genetic algorithms inspired by Darwinism (variation, adaptation through selection), or mechanical algorithms like market models, have provided and continue to provide a reservoir of extremely useful applications for the creation of virtual humans, their morphologies, their behaviors in a particular situation or their interaction with other beings and things.
8 The term was initially used by the Czechoslovakian writer Karel Capek in his play R.U.R. (Rossum’s Universal Robots), which was first performed in 1921.
12 See Harold Rosenberg, The De-definition of art, copyright 1972 by Harold Rosenberg. This work was translated into French under the title La Dé-définition de l’art (Paris: Jacqueline Chambon, 1992).
16 Stern [15] p. 100. To support his theory, Stern emphasizes a neologistic fact: the discovery of "adaptive oscillators" that act like clocks within the body and synchronize our actions with those of others in order to ensure our individual survival.
17 Adam Smith, La Richesse des nations (1776). In fact, Adam Smith...
here recapitulates an idea of David Hume, who, in his Traité de la nature humaine. Essai pour introduire la méthode expérimentale dans les sujets moraux, written between 1739 and 1740, had already seen in sympathy a means of intersubjective communication allowing us to put ourselves in the place of others and share in their suffering or their joy.

18 Theodor Lipps, Ästhetik. Psychologie des Schönen und der Kunst (1903).


22 A length imposed by the battery life, which will not extend any further.


25 See Ref. [23].

26 The performance took place at the Maison des Arts de Créteil, 14–15 April 2015.


ANNOUNCEMENT

Leonardo Art Science Evening Rendezvous (LASER)

Since 2008, the Leonardo Art Science Evening Rendezvous (LASER) series of lectures and presentations on art, science and technology has provided spaces for progressive thought leaders to come together to form community and explore the intersections of disciplinary thinking. Owing to its success and popularity, LASER has expanded beyond its birthplace in the San Francisco Bay Area, first to the U.S. East Coast, then across the Atlantic to London—the home of the first European LASER—and today continues to expand to new locations nationally and internationally. We thank all of those who have spoken at, participated in or attended LASER events throughout the years. We owe a special thank you to Piero Scaruffi, LASER founder and chair, for his inspiration and continued dedication, and to the growing list of LASER hosts around the world. To follow LASER events, see www.leonardo.info/laser-talks.