Adriano D'Aloia

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The intangible ground

A neurophenomenology of the film experience

Adriano D'Aloia

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> The constitution of a spatial level is simply one means of constituting an integrated world: my body is geared onto the world when my perception presents me with a spectacle as varied and as clearly articulated as possible, and when my motor intentions, as they unfold, receive the responses they expect from the world. This maximum sharpness of perception and action points clearly to a perceptual *ground*, a basis of my life, a general setting in which my body can co-exist with the world.[1] – Maurice Merleau-Ponty

Relatively recent discoveries in neurocognitive research have revealed that the human brain's architecture is functional to an immediate and pre-reflexive comprehension of the meaning of goal-directed actions and intentional emotions. This immediate comprehension is allowed by the activation of brain cells in the ventral premotor cortex (area F5) in primates. The so-called 'visuomotor neurons' – i.e., 'canonical neurons' and 'mirror neurons', whose function will be extensively described and discussed below – respond during both action execution and object presentation, regardless of whether the subject is anticipating, imagining, or watching someone else performing the action. The immediate comprehension allowed by neural activation thus relies principally on an intimate connection between *action and perception*.[2] In this sense, the role of visuomotor neurons can be thought of as an opportunity to extend film spectatorship theory. The neurocognitive findings, in fact, permit new interpretations of the psychophysical participation of the film viewer, for the film experience is an intensified *sensory* stimulation that does not correspond to any explicit *motor* activation.

The vivid and engaging nature of the audiovisual experience, particularly in character-driven narrative films, is specifically functional to the creation of a relationship between the spectator and the world of the film based on the perception of observed intentional actions.[3] This essay explores the idea that the film spectator experiences a *tangible* relationship with the filmic objects, subjects, and environments by simulating the character's actions and bodily postures. The hypothesis is evaluated in a theoretical neurophenomenological framework,[4] with the aim of rethinking film spectatorship in the light of a perspective created by combining the results of neurocognitive and neurophysiological experiments with a phenomenological interpretation of the human experience.

In a departure from traditional cognitive theory of mind, neurocognitivists claim that this immediate and automatic comprehension of the meaning of observed or imagined actions is the result of a simulation described as *embodied* – that is, an 'internal representation' of the observed action.[5] Embodied simulation does not entail any inference from the other's mental states (as in the Theory-theory account) or an imaginative substitution – a deliberate and conscious adoption of the other's perspective (as in the 'standard' mode of simulation proposed by Simulation theory).[6] Rather, it is rooted at the sensorimotor and neurophysiological level and is pre-logical and pre-reflexive. The embodied-simulation hypothesis provides empirical evidence that not only is the spectator a witness to the actions represented on screen but also, moreover, s/he internally *acts out* and simulates the intentional actions executed by a film character. The functioning of mirror neurons in particular is described as the neurophysiological substrate of the human ability to understand the meaning of others' actions and state of mind: that is, *empathy*.[7] Empathy is a notion widely discussed in cognitive film studies over the last twenty years and has been thought of in terms of *mindreading* and perspective-taking, according to Simulation-theory.[8] The 'mirror mechanism', as the neurological correlate of the understanding of the character's intentions and inner state, can relaunch the debate under a new and more radical (i.e., embodied) conception of simulation in the film experience.[9]

Interest in neuroscience from the perspective of film theory has increased over the last decade, as can be seen by the publication of books, collective volumes, and journal special issues on neuroaesthetics[10] and kinaesthetic empathy and film.[11] The most widely-accepted attempt in this direction is that of cognitivist scholar Torben Grodal,[12] who, while drawing on neuroscientist Antonio Damasio's embodied theory of mind and emotion,[13] proposed a bio-evolutionist conception of the film experience as a flux that follows the architecture of the brain. In the wake of the Deleuzian idea that 'the mind is the screen',[14] Patricia Pisters has recently proposed to use neuroimaging methodology in order to investigate the experience of the film viewer;[15] many other academics working in film studies are also integrating neurocognitive findings into their research.[16]

Neurophysiologists have already started to study how the human brain experiences film, using fMRI, PET, and other non-invasive neuroimaging techniques. In his proposal for a 'neurocinematics', Uri Hasson studied brain activity in subjects watching 'structured' and 'unstructured' films in order to investigate the extent to which cinema 'controls' viewers' brain activity and orients their attention.[17] Nevertheless, the interest of neuroscientists in the moving image is limited to quantitative measurements or topological identifications of activated brain areas. Although the correlation between the neural mechanisms and cognitive processes makes the film experience a natural application context to study, the results cannot yet describe it accurately enough.

Perhaps for these reasons, many 'continental' film theorists are sceptical of the potential reductionism in neuroscience and do not feel the need to provide a neurocognitive explanation of phenomena that philosophy has already described. The phenomenological approach to the film experience proposed since the 1990s by Vivian Sobchack relies on an implicit incorporation of film's expressive activity in the perceptual experience of the viewer,[18] whose body 'already knew' what the mind inferred and reflexively interpreted.[19] This kind of 'carnal thought' implies but does not make explicit the role of brain processes; it theorises an *embodied mind* without any reference to the neural mechanism of simulation. Above all, in the phenomenological account of the film experience, the camera is described as 'anthropomorphic' in the sense that its behaviour is phenomenologically comparable (though not ontologically analogous) to that of human beings. In this sense, the spectator and the film (and not merely the character) are conceived as sensuous entities that keep up a special kind of intersubjective relationship based on synaesthetic contact. Haptic perception has been theorised as the spectator's elective means of perceiving the film-body and its 'skin' as a sensory experience.[20]

Notwithstanding these premises, phenomenology and neuroscience are still distant. A neurophenomenology of the film experience may fill this gap – or at least mitigate this apparent mutual incompatibility and create the conditions for a theoretical convergence.[21] Not by chance, aware of the ‘reductionist concern’, neurophysiologist Vittorio Gallese noted that relevant phenomenological reflections can be found in the results of neuroscientific studies and that the findings of empirical research in cognitive neuroscience can provide a valuable contribution to a new formulation (if not a resolution) of several philosophical issues that for decades have remained at the core of phenomenological research.[22] In this light, Gallese frames the hypothesis of embodied simulation within the paradigm of *embodied cognition*, in that ‘cognition depends upon the kinds of experience that come from having a body with various sensorimotor capacities, and [...] these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context’.[23] In the wake of Maurice Merleau-Ponty’s notion of body[24] conceived as a combination of a physical structure (the biological body) and an experiential structure (the living, moving, suffering, and enjoying body), this paradigm in cognitive science refers to the grounding of cognitive processes in the neuroanatomical substratum of the brain and to the derivation of cognitive processes from the organism’s sensorimotor experience.

Tangible intangibility

In this theoretical framework, ‘mirroring mechanism’ and ‘embodied simulation’ can be thought of as the very core processes of film ‘viewing’ as an experience of *tangibility*. By *tangibility*, I mean the spectator’s ability to sense a *contact* with the world of the film via specific sensorimotor processes that allow her/him to act *through* the character. The forms of this *tangible contact* are, precisely, the spectator’s opportunity to touch and *grasp* the objects that are touched and grasped by the character; and, in a more general sense, her/his impression of being *grounded* on a supporting surface, as the characters are.

Usually in narrative films characters act effectively and adopt well-balanced bodily orientations. Indeed, the characters can touch and grasp objects according to their intentions and are oriented accordingly to a ‘fictional gravity’ comparable to that in the empirical world. Nevertheless, in order to explore such ‘grasping’ and ‘grounding’, I propose a counterintuitive approach – i.e., to analyse what happens when tactile sensoriality is *not* fully applicable and gravity is *not* valid in the world of the film. When the processes of ordinary perception and the laws of bodily orientation in the fictional world are suspended or disturbed, how does this interfere with the spectators’ perceptual activity and proprioception?

In order to discuss tangibility and contact, I analyse cases of *intangibility* and *suspension* – that is, cases in which tactility and gravity are suspended (at least temporarily) and the character loses the ability to grasp objects and also loses contact with the ground. In particular, I consider two kinds of 'grasping' and 'grounding' experience – hand-grasping and suspension in the void – as expressed in a particular genre in which 'ordinary' gravity does not apply with a diegetic justification: space-exploration films. I have considered spacewalk scenes (i.e., when the astronaut leaves the spacecraft and is engaged in an extra-vehicular activity) in films from the space-discovery golden age (the end of the 1960s) to the 2000s, when the turn of the millennium relaunched the fantasy appeal of space exploration. I shall briefly analyse two spacewalks. Even if reduced tactility and ground-disanchoring are not exclusive to the space-exploration genre (they can be found potentially in any film), spacewalks are a more intensely 'exceptional' situation for the character, one that literally challenges the idea of embodiment and more effectively extends the effects of this potential 'disembodiment' to the spectator.

As regards 'grasping', the reduction of *tangibility* applies to the character's entire body. The extreme and hostile extra-atmospheric environment (too cold and devoid of oxygen) forces the astronaut to protect her/his body and biological functioning by wearing a spacesuit. The spacesuit is both the first level (close to the skin) of a foreign environment and also the separation barrier that allows the environment to be explored, like a technological extension of some kind. It is neither part of the body nor completely outside it, the internal space of exteriority and vice-versa – a labile threshold that simultaneously isolates and connects. Not just a piece of clothing but a protective and insulating cover, a sort of hermetic package, a shape that envelopes the body, the sheath of a being in captivity. In this sense, the spacesuit restricts or at least weakens the astronaut's perception, because it makes bodily movements slow and cumbersome and prevents any direct contact with the external environment, thus reducing tactile sensoriality. More precisely, the spacesuit is an instrument of *desensorialisation*, since it covers the astronaut's body entirely; also, it is the *medium* that makes the exploration experience possible. This possibility of action through mediation can be seen as a *less intense* behaviour simulated by the spectator in terms of neural activation, which is, as neuroscientists affirm, a *less intense* activation of the same cerebral area involved in executing the activity directly.

As for 'grounding', I shall analyse the impact of invalidating gravity and constituting a space that is the result of the interaction (sometimes the conflict) between the 'fictional gravity' that influences the character's actions and movements and the 'empirical gravity' that always applies to spectators on Earth. The general hypothesis is that invalidating gravity deprives this 'experiential environment' of a clear and sharp *orientational* vector of action and motivation. Gravity, in fact, *orients the action* towards its goal and *orients the body* in the environment. Lack of gravity causes lack of *intentionality* and *disorientation*, which in turn causes a lack of *tangibility* (and the respective need to restore tangibility).

These two 'abnormal' conditions ('ungraspability' and 'ungrounding') are particularly effective in narrative films for at least two reasons. First, because the 'classical' development of the story and character action are clearly oriented to a precise goal, not only globally but also 'locally': all actions and movements are perceived by the spectator as *intentional*. Second, because the style of representation is usually ordinary (the ground is *under* the character's feet), and this orientation does not produce perceptive or proprioceptive disturbance in the spectator. In this sense, ineffective actions and suspended postures (which abound in space-exploration films) are not perceived by spectators as *non-intentional* but rather as *incomplete* or *defective* in their intentionality. In fact, they are automatically 'completed' and 'adjusted' by the neurophysiological and perceptual activity of the spectator.

Ungraspability

The first case of intangibility in space-exploration films is the inability to grasp. As mentioned, canonical neurons respond both when a subject grasps an object and when s/he merely sees an object that can be grasped by a prehensile hand movement – as if the subject's brain were foreseeing a possible interaction with this object and preparing itself accordingly. Canonical neurons respond selectively when three-dimensional objects are presented, according to their shape, size, and spatial orientation, codifying not the prehension movement but the intrinsic properties that allow the subject to interact with the object. In other words, objects have tactile features that are immediately *grasped* (both literally and figuratively) by the subject, whether s/he is executing the action or simply imagining or observing it.[25]

Since their discovery, canonical neurons have been linked to the human tendency to instinctively grasp the functional quality of an observed object – that is, the object's *affordance*. The notion of affordance was introduced by psychologist James J. Gibson in 1977[26] to refer to a quality of an object or an environment that allows an individual to perform an action. Gibson further explored this idea in his 1979 book *The Ecological Approach to Visual Perception*,[27] in which he defined affordance as all 'action possibilities' latent in the environment that are objectively measurable and independent of the individual's ability to recognise them. For instance, 'if the object is hand-size, it is graspable; if too large or too small, it is not'.[28] In this sense, following Kurt Koffka's definition of the *demand character*[29] of an object, Gibson affirms that 'each thing says what it is'.[30] This means, for example (in space-exploration terms), that a button says 'push me', a lever says 'turn me', a handle says 'hold me', etc.

As neurophysiologists Garbarini and Adenzato argue in an article on the relationship between affordance and canonical neurons,

> the central point of Gibson's theory was his explicit rejection of the dichotomy between *action* and *perception*. Gibson's pioneering efforts and his ecological perspective certainly represent a fundamental foundation for the paradigm of *embodied cognition*.[31]

In this sense, the pertinence of the notion of affordance in neurocognitive science supports the hypothesis that the reduction or invalidation of gravity – and the consequent reduction of the film character's sensoriality due to difficulties of controlling movements and the need to cover the skin (with the spacesuit and, in particular, the gloves) – generates an interference in the spectator's perception of affordances.[32]

It is important to clarify that canonical neurons work in association with mirror neurons, which respond to observations of actions executed by *other* individuals. While a person observes the action of another subject, the former's neural system evokes a mirrored response, as if s/he were carrying out that action her/himself. Thus, a visually-observed movement seems to be *reflected* in the motor representation of the same movement in the observer. Interestingly, these neurons fire only when the action is 'transitive' and goal-directed: for example, when hands interact with an object (but not when they gesticulate). This means that to be mirrored at a neural level the movement needs to interact with an object and to be aimed at achieving a determined goal. Indeed, neuroscientists have proposed a classification of mirror neurons based on different types of transitive hand movements, e.g. grasping, holding, manipulating, and releasing.[33]

What happens when the character's hands *fail* to grasp the object that they *intended* to? Clearly, failed hand-prehension and reduction of touch sensoriality do not occur exclusively in fictional extra-atmospheric environments (i.e., in space-exploration films). Nevertheless, lack of prehensibility, in terms of lack of *intentionality*, is particularly incisive in such environments, since the 'literal embodiment' that the astronaut is forced into because of wearing the spacesuit and the gloves is particularly relevant if we relate the activity of visuomotor neurons – in particular canonical neurons – to the notion of affordance.

In order to delve into this dynamic, let us consider an example. In *Mission to Mars* (Brian De Palma, 2000), as the spaceship is prepared to enter Mars' orbit, a swarm of meteors collides with the hull, breaching the ship. The crew work quickly to repair the damage, but they forget about the external oxygen tank, causing a large leak and subsequent explosion. They swiftly put on pressure suits, abandon the craft, and try to reach the REMO (REsupply MOdule) orbiting the planet, tethered to each other in outer space by a cable. The module, however, is moving at such a speed that the astronauts need extra thrust to reach it. Woody Blake (Tim Robbins) concludes that the only hope of a successful rendezvous with the REMO is to launch himself directly at it using the remainder of his jet-pack fuel, carrying a tether cord from the others. He successfully attaches the cord to the REMO but because of its inertial speed (and the law of conservation of momentum), he is unable to land properly on the module and to arrest his motion. He frantically grabs at the door handles or for some other handhold, clawing at the surface with a harsh, grating sound. Woody floats helplessly away towards the planet with a dwindling oxygen supply. Woody's wife, Terri (Connie Nielsen), begins a rescue bid to bring him back – but knowing that Terri will almost certainly fail to save him and would probably also die trying, Woody removes his helmet and dies from instant frostbite.

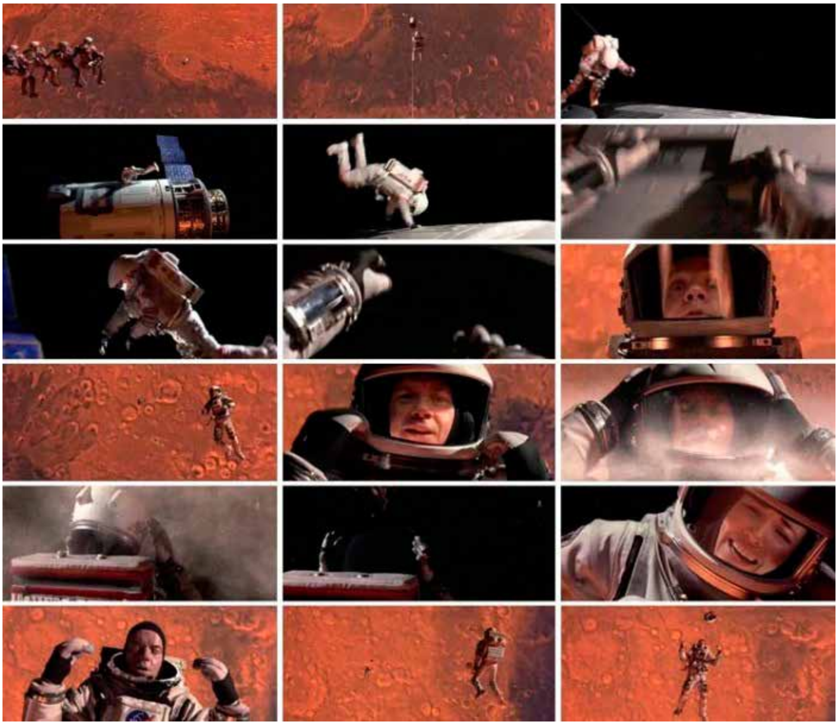

Fig. 1 *Mission to Mars* (*Brian De Palma, 2000*)

The formal style of representation combines a montage of shot sizes and points of view of various kinds, focusing on the character's capacity to accomplish his intentions: he cannot control his motion speed or the course of events. This limitation depends on environmental conditions (such as weightlessness and absence of gravity) that also affect the prehensive action of his hands, which are literally 'embodied' in dedicated spacesuit components – the gloves – and are unable to carry out their functions (in this case grasping). The gloved hands are agents of perception that act frantically because they are unable to make direct contact with the external world and the objects in the surrounding space. The hands fail to grasp because of the very *medium* that allows the astronaut to explore outer space.

According to the neurological account of action simulation, although the spectator's hands do not *actually* touch or grasp, they experience touching and grasping at a neural level. The REMO handle's 'grasping' affordance is properly suggested by representation, in which a tracking shot towards the REMO (Woody's point-of-view) and shots of Woody's hands ready to seize the module's handle and of his colleagues' anxious faces are clearly *directed to* the action's goal and express the character's intentions.[34] Nevertheless, the gloves and the uncontrollable speed prevent the character from grabbing the handle successfully. In other words, although the spectator's canonical neurons activate in order to grasp the object (the visuomotor part of the process runs normally), the observed subject fails to execute the action (since the motor part of the process is 'defective'). In this sense, the spectator grasps an object that is ungraspable for the character. Once a goal-directed action begins, in fact, the visuomotor neural activation in the spectator's brain allows the latter to comprehend the intentions implied in the observed action, even if the planned action does not have a successful outcome. If the character's action is *intentional* (i.e., goal-directed), then this action and the intentions behind it are simulated by the spectator; the act of grasping is experienced by the spectator, even if the character's hand fails to reach its goal.

More precisely, the film spectator's experience is twofold: s/he experiences the character's failed action, the ungraspable – the tangible experience of intangibility. Although the gloves and gravity reduce tactile sensoriality and movement control and lead the grasping action to fail, the spectator can still perceive it. Indeed, this failure more effectively expresses the character's condition of hypo-sensoriality and enables her/his condition to be simulated more accurately. The spectator directly feels a desensitisation, the absence of tactile sensoriality. Neural simulative activation can be seen as a strategy deliberately adopted by the filmmakers. In fact, it works as compensation for the lack of the character's sensoriality, since it completes the uncompleted or failed action. If the object affords grasping, then the observer *does* grasp it in terms of embodied simulation.

Ungrounding

The second case of intangibility concerns the problem of equilibrium, sense of position, and being grounded to a support surface. In the description of extra-vehicular activities in space-exploration films, the term 'suspense' may refer not only to the state of anxious uncertainty about what may happen in the film but also to the character's physical state of suspension. The orientation and movement of a body in space depend on the physical features of the environment. Out in space, bodies are too far from the ground to be subject to gravity (that is, to the risk of a possible fall), and the notion of suspension – as well as any other kinds of relationship between bodies and space (e.g., that of up and down) – has a different meaning from that in gravitational fictional worlds. In this sense, my hypothesis is that the spectator's impression of being disoriented and suspended is imputable to their *inability to touch the ground*.

It has to be said that, along with the reduction of touch sensoriality, relativity of orientation is another feature not exclusive to the space-exploration genre. In every film experience fictional gravity and empirical gravity work together (and partially against each other) to define the general frame of orientation. The character's orientation on screen, in fact, is independent of the gravity that is supposed to apply in the world of the film. This relativity is demonstrated by the recurring use of upside-down images in films set on Earth, in which the representation of upturned bodies has an expressive or spectacular aim, rather than being justified diegetically (e.g., where the character is upside-down in the film-world).[35] In extra-vehicular activity in space-exploration films, the use of upside-down images is much more evident and functional to a 'realistic' representation of the orientation of the astronaut's body in the environment and in communicating to the spectator the character's state of suspension. Whether the character is represented as upside-down or upright, the fictional zero gravity can extend its influence to the spectator's sense of position and bodily orientation, even if the latter is in an environment where gravity applies.

An interesting example can be found in a crucial scene in *2010: The Year We Make Contact* (Peter Hyams, 1984). Engineer Walter Curnow experiences his first spacewalk to reactivate the Discovery, which astronaut Dave Bowman had deactivated shortly before his journey 'beyond the infinite' in *2001: A Space Odyssey* (Stanley Kubrick, 1968). Curnow hesitates before leaving the spaceship and moving into the void over Jupiter's surface. He is noticeably anxious and frightened; his breathing is laboured and his wide-open eyes, face contorted with fear, can be seen behind the helmet visor. Once outside the spaceship he remains in a clumsy posture with his arms wide apart, as if trying to keep balance and, at the same time, avoid falling (though falling is impossible). In a gravitational environment, the character would be like an acrobat walking on a wire – Curnow must literally walk on the void, and his acrophobia is increased by a more cognitive fear connected to his inexperience as an astronaut: that of the void as the *unknown*. Like the character, the spectator is invited to experience the same extraordinary situation, remote from her/his everyday life. The point is to understand how the spectator simulates this psychophysical situation from her/his position in the *gravitational* environment of the film theatre.

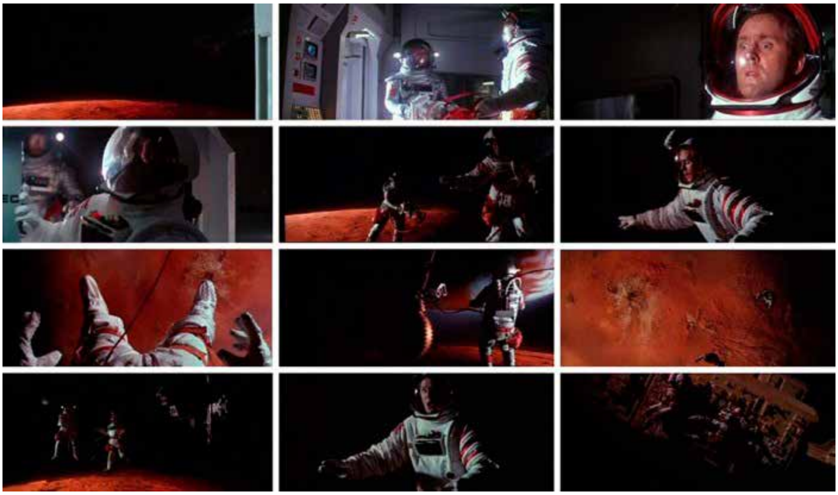

Fig. 2 *2010: The Year We Make Contact* (*Peter Hyams, 1984*)

The spectator's involvement is constructed from two seemingly opposing strategies: synchronisation of affective reactions and disturbance of vestibular sense. As for the first strategy, given the intensification of the character's reactions, thanks to physiological mechanisms the spectator's breathing tends to change – to synchronise with the astronaut's so as to feel the character's stress, *as if* the spectator were the one finding it hard to breathe in the constricted space of the helmet; the spectator's muscles tense *as if* s/he were the one forced to perform a spacewalk for the first time. Whereas this strategy has been widely described by cognitive film theory and recognised (as mentioned earlier) as the basis for the construction of sympathetic and empathetic relationships between the spectator and the character, the second strategy can be described in the framework of the ecological approach to perception, and it needs more explanation.

In his book, Gibson also discusses the so-called 'visual cliff' experiment conducted in 1960 by Eleanor Gibson and Richard Walk.[36] The experiment aimed to investigate the perception of depth in child and animal species. The apparatus consisted of a sheet of Plexiglas over a cloth with a high-contrast chequerboard pattern. On one side, the cloth is placed immediately beneath the Plexiglas; on the other, it is dropped about four feet below. Since the Plexiglas supports the weight of the infant, this is a visual cliff rather than a physical drop. The subjects' behaviour varied according to the absence of *optical information*, given the presence of *tactile information* determined by the physical contact between their feet or arms and the support. When the cloth was four feet below, the subjects showed signs of disorientation and even fear. As Gibson stated,

> [t]he optical information in this experiment, I believe, is contradictory to the haptic information. One sees oneself as being up in the air, but one feels oneself in contact with a surface of support and, of course, one feels the normal pull of gravity in the vestibular organ.[37]

The subject's disoriented behaviour depended on the emergence of inappropriate affordance:

> a surface of support was mistaken for air because the optic array specified air .... Air downward affords falling and is dangerous. Air forward affords passage and is safe. The mistaken perception led to inappropriate actions.[38]

In other words, 'the brink of a cliff affords falling off; it is in fact dangerous and it looks dangerous to us';[39] where a transparent and thus visually unperceived surface of support extends out over the edge, 'it no longer affords falling and in fact is not dangerous, but it may still *look* dangerous'.[40] This interference between how it looks and how it is perceived generates a bodily conflict.

When the film succeeds in expanding the dynamic forces of the fictional environment out of the screen and into the darkness of the theatre, spectators are immersed in the represented space, in a common non-gravitational space of experience. In this case, spectators have the impression of being disoriented and suspended in the same void where the astronaut is. Nevertheless, proprioception never completely disappears from the observer experience. As Gibson stated, 'the continuous act of perceiving involves the coperceiving of the self',[41] meaning that the information on the world that the subject received implicitly includes information on the self. 'My perception of the world is at the same time shot through with information about my own embodied position in that world.'[42] In fact, the spectator's experience is conditioned in that they can move their feet and feel for a support that is there in the real world regardless: this 'ground' is provided by the presence of tactile sensation in the gravitational environment of the film theatre, whilst the screen can be thought of as the transparent part of the support in the visual-cliff experiment. The feeling of dizziness and disorientation arises because optical information (of void) does not correspond to the tactile information (of being grounded).

Curnow's unpleasant state of disorientation is expressed through a formal style that conveys a 'psychophysical *suspense*' to the spectator. This suspended condition depends on the film's capability to extend the optical/tactile conflict to the spectator's sensoriality, to the extent that the latter loses (at least temporarily) the sensation of being grounded to a surface of support, even though the surface is still there. By virtue of embodied simulation, in the immersive darkness of the movie theatre, the spectator senses an incongruity between what is seen and what is felt – i.e., between the tendency to simulate the character's bodily situation and the proprioceptive conservation of the self.

It is interesting to note that the stylistic strategies of representation used in *2010* are aimed, as it were, at 're-embodying' the disembodied sensoriality caused by the interference of optical and tactile information. This 're-embodiment' consists of proposing a mutual orientation of the character's and the spectator's sensoriality so as to position the former as if s/he were in a gravitational environment. In the *2010* scene, as Curnow passes through the spaceship door, his state of agitation is not a vague fear of the void but rather a precise fear of altitude. A close-up shows his face as he tries not to look *down*; a point-of-view shot shows his legs and, *under* them, Jupiter's surface. Although there is no diegetic reason to orient the astronaut and the planet in this position, and although the spectator's guess that the character's fear depends on his fear of the unknown and the vacuum, the film reproduces the 'everyday life' (i.e., gravitational) orientation in order to convey giddiness and acrophobia, to elicit the same feeling and the same proprioception that would be felt in a gravitational situation. The film uses a 'gravitational aesthetic' even in a non-gravitational environment, to communicate suspense and fear to the spectator. In this sense, the character's inappropriate behaviour due to contradictory affordance is experienced *properly* by the spectator – an extraordinary activity is experienced ordinarily.

The sense of void

The neurophenomenological approach that I have proposed demonstrates that every film experience is characterised by the potential conflict between optical and tactile information, and that film uses this interference to generate a sense of suspension and suspense in the spectator due to a lack of tangibility. I have analysed two cases of intangibility in space-exploration films, in which intangibility is a constitutive element of representation, in particular in spacewalk scenes.

First, the representation focuses on a lack of hand-prehension efficacy. Because of spacesuit gloves and the absence of gravity, the character's tactile sensoriality and control of movement are reduced. When a hand-prehension action performed by an astronaut during a risky operation fails, the object is perceived as ungraspable, *intangible*. The spectator experiences the sense of ungraspability of a nevertheless graspable object; s/he feels the desensorialisation that affects the character.

However, the mediated nature of the film experience and the combination of perceptual dynamics (*synaesthesia*) and psychological processes (*affordance*) serve to 'invert' desensorialisation in a special kind of sensoriality that is specific to the film experience. This special form of sensoriality is rooted in the neurophysiological mechanisms (*embodied simulation*) that automatically activate in the spectator's brain. Visuomotor neurons, in fact, play a role in the impression that spectators have of grasping objects or touching surfaces even when they are *not* grasped or touched by the character. Through visuomotor neurons, when a subject observes a graspable object, s/he does grasp that object. Similarly, the spectator accomplishes the character's intention, finalising the grasping action on behalf of the character.

The visuomotor activation works to complete the character's incomplete action. In fact, visuomotor neurons codify the objects' intrinsic properties, allowing the spectator to interact with them (affordance related to canonical-neuron activation) through an embodied simulation of the character's actions and intentions (affordance related to mirror-neuron activation). Moreover, when a tactile action is executed by the character, visuomotor neuron activation provides a special kind of 'com-prehensive experience' that connects the visual information of the image and the tactile impression of touching the fictional object. By virtue of synaesthetic perception, when a subject observes another subject touching, say, a rough surface, s/he does sense its roughness – even if the character's skin is covered by a mediation surface, such as gloves. Bridging the visual and the motor system at a neurological level, visuomotor neurons can be seen as the neural substratum of synaesthetic perception.[43]

Second, the same dynamic is valid in regards to whole-bodily sensoriality, as the spectator simulates the character's state of suspension and detachment from the ground due to lack of gravity and weightlessness. This 'unsensoriality' of the character extends its influence to the spectators, since external perception also affects the spectator's sense of space and relationship with the outside world. As the application of the visual-cliff experiment to filmic spacewalks demonstrates, the spectator experiences a contradiction between the affordance of falling and that of support, because the character is deprived of both optical and tactile information. Since the relativity of filmic orientation both liberates and disrupts the usual framework of movement, when this contradiction arises, the spectator initially experiences disorientation and receives the impression of having lost contact with the ground. Nevertheless, although the spectator derives pleasure from the destabilising effect of being upside-down, s/he soon needs to be reoriented and tends to establish a new system of reference based on her/his own body. Proprioception thus acquires a crucial role in re-grounding the spectator's body in respect of that of the astronaut in the void. Narrative film often negotiates the conflict between loss of position and proprioceptive sensibility on behalf of the spectator, embodying in its stylistic and formal solutions the spectator's natural tendency towards psychophysical equilibrium. This strategy has the effect of restoring *intentionality* and *tangibility* to situations in which the lack of gravity causes a lack of *orientation to* a goal (that is, very often, to survive in hostile environments such as deep space).

In sum, the *mediated* nature of film experience and the *simulated* nature of the viewer's participation are constitutive factors of a paradoxical experience that makes the *intangible tangible*. The case of extra-vehicular activity in space-exploration films demonstrates that the spectator's is a twofold experience. The desensorialisation caused by the character's spacesuit and weightlessness frustrates the viewer's automatic tendency to simulate and perform (even less intensely) the observed intentional action or bodily postures and orientation. The spectator experiences the same desensorialisation and impediment to finalising a goal-directed action. On the other hand, embodied simulation relies on the immediate comprehension of intention based on neural sensorimotor activation, and this neurophysiological activation is the substratum of visual and synaesthetic perceptual processes. These facts give rise to a *full experience* even when the character is not able to fully perceive or complete the action, or to have a stable sense of equilibrium and a proper proprioceptive sense of position.

This strategy of detachment and re-attachment, 'disembodiment' and 're-embodiment', desensorialisation and re-sensorialisation through intensification of haptic perception, in addition to visuomotor neural activation and proprioception, expresses the lack of tangibility and its recovery on at least three levels of experience. On a basic physiological level, a 'sensorimotor void' is expressed via ungraspability and weightlessness, both mirrored and compensated by the spectator's natural tendency to implicitly simulate the character's actions and postures. Also, at a cognitive level, a state of suspense is conveyed through the lack of com-prehensibility and the detachment from the ground. This 'cognitive intangibility' manifests itself in the difficulty of interpreting the ineffective and uncontrolled gestures of the characters and their movements in space. The implicit understanding of the character's intentions is functional to an explicit and narrative comprehension of the film. Suspense is almost a sort of suspicion related to story development – i.e., a feeling of danger, the imminence of an irreparable tragedy.

The psychological implications of canonical and other neural activity suggest a more figurative meaning of 'grasping', as the subject's ability to *understand* the character's intentions. In this sense, the act of comprehending a *manipulative* action can be related to the general act of understanding the deep meaning of action and, more generally, the meaning of the film. Finally, the spectator is invited to face inefficacy and unbalance as a 'sense of void' that can also be understood, philosophically, as an 'existential loss'. In this sense, the ground has to be conceived of as a point of both material and symbolic reference and orientation that is lost and that needs to be replaced. Spatial emptiness and the body's detachment from the ground can be perceived by aware spectators as a form of remoteness from human nature itself – that is, the lack of a *grasp* on the world in which we are temporarily *grounded*.

Notes

1. Merleau-Ponty 2002, p. 292.
2. For a comprehensive illustration of the history of the discovery of visuomotor neurons and their functioning, see Rizzolatti & Sinigaglia 2008, Iacoboni 2009.
3. The analogy between cognitive processes active during recognition and evaluation of others in *face-to-face* and in mediated experience has been demonstrated empirically. See Hoffner & Cantor 1991.
4. On neurophenomenology, see Varela 1996, Cappuccio 2006.
5. On embodied simulation, see Gallese 2005, 2009a.
6. On mental simulation, see Gordon 1986, Currie & Ravenscroft 2002, Goldman 2006. On the debate *Simulation-theory/Theory-theory* in cognitive sciences, see Gallagher & Zahavi 2007.
7. Gallese 2001, 2003; Carr *et al.* 2003; Iacoboni *et al.* 2005.
8. See Smith 1995, Tan 1996, Grodal 1997, Plantinga 1998. For a summary of the debate on empathy in cognitive film theory, see Neill 1996, Coplan 2006, Bruun Vaage 2010.
9. The first attempt to link mental simulation and embodied simulation appears in Gallese & Goldman 1998.

10. See, for example, the special issue on 'Film & Neuroaesthetics' in *Iluminace*, No. 4, 2012; the special issue on 'Embodiment and the body' in *Cinema: Journal of Philosophy and the Moving Image*, No. 3, 2012; the issue on 'The Varieties of Empathy in Science, Art, and History', *Science in Context*, No. 3, 2012.
11. See, for example, Reason & Reynolds 2012.
12. Grodal 2009.
13. See Damasio 1994, 1999.
14. Deleuze 2000.
15. Pisters 2012.
16. Gallese & Guerra 2012.
17. See Husson *et al.* 2008a, 2008b.
18. Sobchack 1992.
19. Sobchack 2004.
20. See Marks 2000, 2002; Beugnet 2007; Barker 2009; Laine 2011.
21. See Elliott 2010.
22. Gallese in press. See also Petitot, Varela, Pachoud & Roy 1999.
23. Varela, Thompson & Rosch 1991, pp. 172-173. On embodied cognition, see also Lakoff & Johnson 1999.
24. Merleau-Ponty 2002.
25. Gallese *et al.* 1996; Rizzolatti *et al.* 2004; Keysers *et al.* 2004; Gallese 2009b; Carpaneto *et al.* 2011.
26. Gibson 1977.
27. Gibson 1979.
28. Ibid., p. 234.
29. Koffka 1935.
30. Gibson 1977, p. 138.
31. Garbarini & Adenzato 2004, p. 101.
32. On the relevance of the ecological theory for film studies, see Anderson & Fischer-Anderson 2005.
33. See Rizzolatti & Fadiga 1998.
34. On visuomotor neurons, camera movements, and point of view, see Gallese & Guerra 2012.
35. On the use of upside-down images in the film experience, see D'Aloia 2012.
36. Gibson & Walk 1960.
37. Gibson 1979, p. 157.
38. Ibid., p. 142.
39. Ibid.
40. Ibid., p. 227.
41. Gibson 1979, p. 240.
42. Gallagher & Zahavi 2007, p. 270.
43. See Blakemore *et al.* 2005; Banissy & Ward 2007.

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About the author

Adriano D'Aloia is a postdoctoral researcher in the Department of Communication and Performing Arts of the Università Cattolica del Sacro Cuore, Milan. He received a Ph.D. for his dissertation *Empathy in the Film Experience* (2010). D'Aloia is the author of a forthcoming publication on contemporary film experience from the perspective of aesthetics, psychology, and neuroscience. He is curator of the collection of Rudolf Arnheim's Italian writings on cinema (*I baffi di Charlot. Scritti italiani sul cinema 1932-1938* [Torino: Kaplan, 2009]) and his essays have been published in the journals *Bianco e Nero*, *Cinema: Journal of Philosophy and the Moving Image*, *Cinéma&Cie*, *Film-Philosophy*, *Iluminace*, *montage a-v*, and *Screening the Past*. His blog can be found at http://anideaaday.wordpress.com.