

THE REMOTE BODY: THE PHENOMENOLOGY OF TELEPRESENCE AND RE-EMBODIMENT

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Abstract: *Exploring the phenomenology of remote practices made possible by recent technological advances, such as telesurgery, will reveal the role of proprioception in agency and ownership of action and furthermore delimit the possibility of re-embodiment through technological interfaces. An understanding of the lived body, viewed through the philosophical paradigms of theorists Husserl and Merleau-Ponty, will demonstrate the role of the corporeal schema and intercorporeality in an agent's interaction with the immediate environment and hence elucidate the limits of achieving a seamless remote interaction as good as the "real thing." These considerations are fundamental for grounding the bioethical, legal, and epistemological issues that arise in remote interaction, particularly in the case of telesurgery.*

Keywords: *telepresence, re-embodiment, remote environment, telesurgery, phenomenology.*

INTRODUCTION

Telepresence is a relatively recent term, coined to describe a wide range of experiences that pervade human life in the technologically advanced and affluent developed world. Jonathan Steuer has defined telepresence as "the experience of presence in an environment by means of a communication medium"; it is the mediated perception of a "temporally or spatially distant real environment" through the means of some sort of telecommunications technology (Steuer, 1995, p. 36).¹ Most citizens of the developed world are familiar with this experience of a window opened up onto a distant environment through their engaging everyday activities such as watching live television footage, accessing webcams, or using video conferencing technology.

Telepresence technologies share many characteristics with the technologies that have been developed for use in virtual reality (VR). VR is distinct from telepresence in that it involves the use of three-dimensional computer graphics technology to generate artificial environments in which one is immersed (Murray & Sixsmith, 1999, p. 316). However, VR and telepresence are similar in that one of the main aims of both of these technologies is to create the sense of presence, of "being there," in the environment (remote or virtual) with which

which the user is engaged (Murray & Sixsmith, 1999, p. 324). For presence to occur, the technological interface and the immediate surroundings must recede from the user's awareness, enabling the transparency of the hardware to provide access to the remote environment. In this case, one does not feel as though he/she is just interacting with a technological medium that gives mediated access to a virtual or remote environment; rather, the user feels as though he/she is really *there*.

Presence in telepresence and VR was initially equated with a capacity to adequately see and examine the remote or virtual environment through the medium of sight. Optical technologies provided observational access to the distant or virtual environment; the olfactory, haptic, and auditory senses were neglected. As a result, the development of these technologies reflects a cultural habit of the Western sciences to privilege vision as the most important perceptual sense (Ihde, 2002; Murray & Sixsmith, 1999). Indeed, optical technologies, such as the telescope, microscope, and camera, have long been considered the means through which scientific truths can be accessed and presented, and imaging technologies are frequently employed to present scientific evidence in visual form when it is beyond the realm of the human visual field (Ihde, 2002). Early telepresence technologies reflect this implicit bias in science: Access to other environments has primarily been visual and the rest of the body's senses and motor capacities have been neglected, ignored, or considered of marginal significance.

The privileging of vision in technological developments for telepresence and VR demonstrates the extent to which they have been developed under the implicit assumptions about the nature of selfhood under a certain philosophical paradigm, namely the Cartesian-Lockian model (Malpas, 2000). This philosophical model considers the subject to be a metaphysical psychic and intellectual entity housed inside a physical substrate and causally connected to the outside world through the sense organs and the body, controlled in a mechanistic manner and described by the laws of the natural sciences.² Under the Cartesian-Lockian model, all knowledge is representational; that is, it is as if "each of us was locked within a single, solitary cell and connected to the world beyond by nothing more than a combination of video, audio and other information systems, coupled perhaps with some device for remote manipulation" (Malpas, 2000, p. 112). Many advances in technologies, particularly in communications and entertainment, have been achieved following this philosophical paradigm, resulting in many new and innovative ways to present representational knowledge.

However, recent advances in telepresence technologies, which have extended the experience of being present in a remote environment to one of physically interacting with that environment, have demonstrated that the Cartesian-Lockian model is particularly inadequate to account for the embodied experience of the subject exerting physical motive force in order to perform precise and deliberate movements in a distant environment, far beyond the crude causal mechanisms of remote control. Indeed, recent developments in robotics have made it possible to displace very precise intentional motor actions into remote locations. In this paper, I will specifically draw on the example of telesurgery, where surgical operations are performed at a distance by a surgeon remotely manipulating robotic arms.

It will be seen that the notion of the self as a disembodied entity with mediated and representational access to the world through a causally manipulated physical body will not serve to adequately describe the experience of telesurgery, or other telepresence activities for that matter. The Cartesian-Lockian model, which initially served as a philosophical paradigm for the developments of technology, has been disputed with the phenomenological investigations

of embodiment and situatedness from philosophers such as Husserl and Merleau-Ponty. Hence, I will draw on their work, as well as that of some contemporary commentators, to address some pressing philosophical issues that arise in telepresence, such as the limits of the corporeal schema, motor-intentionality, agency and ownership of action, the possibility of re-embodiment, and the role of intercorporeality. Acknowledging that the body is not merely an appendage to the self, but rather is the means through which any meaningful engagement with the world is possible, calls for a careful understanding and rethinking with regard to the development and success of telepresence technologies.

UNDERSTANDING TELEPRESENCE

Distinguished from the concept of presence in virtual reality, telepresence is an experience that covers a wide range of phenomena involving interaction with a real, yet remote, environment.³ There are four basic types of telepresence that can be schematized as follows: (a) Observational Telepresence, involving a passive observation of a remote environment (e.g., via a Webcam); (b) Simple Telepresence, involving basic physical interaction with a remote environment through a remote control device, and where the physical input does not necessarily correspond to the physical output (e.g., remote missile launch); (c) Enriched Telepresence, involving multisensory feedback, where movements of the user are precise and intentional and, to an extent, mirrored in the remote environment (e.g., telesurgery); and (d) High-Fidelity Telepresence, perhaps a future reality involving total multisensory immersion, affecting a seamless immersion of the user in the remote environment.⁴ In this paper I will primarily consider the experience of enriched telepresence, where perception of a remote environment is coupled with the ability to provide motive force to act on or manipulate that distant environment. Some early examples of simple and enriched telepresence that have provoked philosophical discussion are *Legal Tender*⁵ and the *Telegarden*.⁶

Legal Tender was the first publicly accessible telerobotic website, where users, after agreeing to take full responsibility for their actions, could destroy or deface two allegedly real US\$100 notes. Damaging legal tender is a criminal act defined by the United States Legal Code⁷, but a crime is committed only if the notes are real, the damaging acts are actually performed, and the Website is authentic. This experiment was an attempt at inducing on-line corporeal risk. When questioned, most participants in the experiment responded that they did not believe that the notes and the experiment were real, and hence did not feel as though they were placing themselves under any risk (Dreyfus, 2000). The *Telegarden* was another Web installation, where remote users could plant seeds, water, and care for a real garden located in the Ars Electronica Museum in Austria. In the case of the *Telegarden*, issues of the authenticity of the garden could be assuaged since it could be viewed and visited on location in the museum; however, doubts still remained about whether user input was authentically linked to performance output.

Philosophical discussion that has arisen as a result of these and other examples of telepresence has primarily focused on epistemological issues addressing questions of authenticity and reality. *Telepistemology* is the stream of philosophical investigation that deals with these issues in the specific case of telepresence (Dreyfus, 2000). Although the epistemological considerations that arise with telepresence are important and of philosophical interest, I will not address them in this paper.⁸ Instead, I will focus on the phenomenological

questions that arise when considering telepresence, in particular questions regarding agency and ownership of action, the limits of the corporeal schema, situatedness, the possibility of re-embodiment and intercorporeality. The case of telesurgery, where invasive surgical procedures are performed remotely, will be examined in order to demonstrate the quality and characteristics of these phenomenological issues.

Telesurgery is perhaps one of the most striking and tangible examples of enriched telepresence, where surgical operations are performed from a remote location using a surgical system⁹ that provides limited multisensory feedback, usually auditory, visual, and sometimes haptic, to the surgeon (Satava, 2005). A useful description is offered by van Wynsberghe and Gastmans (2008):

In most general terms, in a telerobotic procedure, the physician is seated at a surgeon console at a distant site and manipulates remote controls. The joystick or remote control movements are converted into digital signals which travel via the telecommunication network to the robotic system on the patient side. These signals are received by the surgical column and translated from their digital form into movements of the robotic surgical arms within the surgical field (i.e., inserted into the patient). The surgeon oversees these movements through the monitor of the surgeon console which transmits the video of the endoscopic camera, also inserted into the patient. (pp. 1–2)

Telesurgery is part of an ever-growing field in biomedicine, termed “telemedicine,” that utilizes electronic communication to provide clinical and medical care for patients located at distant sites (Silverman, 2003, p. 67).

In the case of telesurgery, the patient and doctor need not be located in the same room, building, or even hospital. In fact, in 2001, the first trans-Atlantic telesurgical operation was performed successfully by a surgeon in New York operating on a patient in France. In this operation, Dr. Jacques Marescaux in New York removed a gall bladder from a 68-year-old woman in Strasbourg, France. The operation was successful and the patient was discharged from the hospital two days after the operation (Marescaux, Leroy, & Rubino, 2002).¹⁰ The considerable distances between patient and surgeon afforded by telesurgery provide opportunities for care and treatment in remote, rural, or hostile environments, such as at sea, on the battlefield, or conceivably extra-terrestrial environments, such as in space stations. Furthermore, using robotic arms allows surgeons to perform minimally invasive surgery (MIS), overcoming limitations of scale and achieving unprecedented degrees of control and accuracy (van Wynsberghe & Gastmans, 2008, p. 1). As a result, the numerous benefits for the patient include reduced recovery time and pain, significantly decreased risk of infection, and, aesthetically, minimal scarring (Hanly & Broderick, 2005).

However, despite the obvious benefits that come as a result of telesurgery, a range of unresolved practical, ethical, and legal concerns arise when considering these procedures. Using robotic systems for surgery can reduce dexterity and haptic feedback for surgeons, resultantly requiring a great deal more training. Biomedical ethicists question whether telesurgery will diminish or augment the level of patient care from an ethical standpoint. Among their concerns are whether telesurgery obscures valuable traditional and social practices, such as the doctor-patient encounter, whether the quality of care is compromised, and whether the patient is dehumanized and objectified (van Wynsberghe & Gastmans, 2008). From a legal standpoint, health policy theorist Ross Silverman highlights four main areas of concern for the regulatory bodies in the USA and Europe when considering telepresence practices in medicine: the establishment of the doctor-patient relationship and consent;

malpractice and cross-border licensure; standardization of practices and patient privacy; and monetary reimbursement for remote exchanges (Silverman, 2003, p. 67).

The legal and ethical concerns that arise as a result of telesurgery must be carefully considered and addressed as improved robotic systems are being developed with the hopes of making telesurgery a routine application (van Wynsberghe & Gastmans, 2008, p. 1). In this paper I will offer a philosophical and phenomenological analysis of telesurgery and, more generally, telepresence. As stated, I will focus on the phenomenological issues concerning the lived body engaging with such technologies. Through exploring and elucidating the qualities of these phenomenological features of telepresence, some insight will be gained that can aid in grounding or resolving the practical, ethical, and legal considerations that arise in telesurgery and other types of telepresence.

PHENOMENOLOGY: THE LIVED BODY, TRANSPARENCY, AND THE CORPOREAL SCHEMA

Advances in telepresence technology that are concerned with experiences of multisensory feedback and physical situatedness have implicitly acknowledged the fact that the Cartesian-Lockian paradigm for selfhood is insufficient in explaining the replete and embodied nature of subjective experience. In cases of enriched telepresence, such as telesurgery, the user does not relate to the technological interface in a merely representational manner, that is, as a disembodied gaze. In contrast, user interaction involves the body interacting with the remote environment through learned and skilled motor behaviors.

As a result, the phenomenological understanding of the lived body as investigated by theorists such as Husserl, Merleau-Ponty, and their commentators, is instrumental to understanding how these technologies work and how interaction with them can be successful. In this section, I will describe the key phenomenological features of embodiment that are of interest when considering how the body interacts with technology. I begin with an overview of Husserl's phenomenological description of embodiment, and how it has been taken up and developed by Merleau-Ponty's existential approach. Subsequently, the themes of bodily transparency, motor intentionality, and the corporeal schema will be explored.

Husserl's Phenomenological Description of Embodiment

Husserl's phenomenological description of the experience of embodiment was, for the most part, published posthumously in the volume *Ideen II: Phänomenologische Untersuchungen zur Konstitution* (Husserl, 1952).¹¹ Husserl, in this work, endeavors to elucidate how the body is not merely a "material thing," but rather that which constitutes the "psychophysical subject" (Husserl, 1952/1989, p. 151).¹² Thusly, he provides a description of the body as a lived entity, identifying several features of the body that render it distinct from other material objects. These characteristics can be schematized into four main features of embodied subjectivity.

Firstly, the living body is distinguished from other material worldly objects because it is sensitive: "Obviously, the Body is also to be seen just like any other thing, but it becomes a *Body* only by incorporating ... sensations" (Husserl, 1952/1989, p. 158–159). Husserl argues that the localization of sensation, which is absent in inanimate material objects, constitutes the

unity of the body and, furthermore, delimits its boundaries. Secondly, we find that, in contrast to other material things that are moved only in a mechanical and mediate way, the living body is immediately expressive and mobile: It is “an *organ of the will*, the *one and only Object* which ... is *movable immediately and spontaneously* and is a means for producing a mediate spontaneous movement in other things” (p. 159). The body, as freely movable, is what allows consciousness to be characterized by Husserl as an “I can” (*Ich kann*), in contrast to the usual Cartesian formulation of an ‘I think that’ (p. 159).

Thirdly, the living body is the “zero point” (*Nullpunkt*) through which all spatial orientations are understood. The body is “a here which has no other here outside of itself, in relation to which it would be a ‘there’”; additionally, all spatial orientations are conceived with respect to the size, shape, and orientation of the body. As such, the body is the center of the realm of possibility and experience, and “I do not have the possibility of distancing myself from my Body, or my Body from me” (Husserl, 1952/1989, p. 167). Lastly, the body is the organ of perception and, Husserl argues, it is necessarily involved in all acts of perception (p. 61). As such, the body makes all experience of the external world possible and manifest. Through setting out these four main phenomenological characteristics of the body, Husserl is able to contend that, under the phenomenological attitude, the body is primarily revealed as a living and expressive organism or psychophysical subject (*Leib*) and cannot be reduced to a mere material thing (*Körper*).

Merleau-Ponty’s Lived Body

It is Husserl’s description of the body and perceptual experience through embodiment that Merleau-Ponty takes up and develops in his highly influential work *Phénoménologie de la Perception* (1945).¹³ Employing Husserl’s main characterizations of the phenomenal body, Merleau-Ponty, writing in the 1940s, gave a richer and more holistic description of the lived body as it is in relation to its lived environment, in particular developing the ideas of the body schema and motor intentionality.¹⁴ Following Husserl, Merleau-Ponty regards the body first and foremost as *Leib*, that is, as a living and expressive organism.

Merleau-Ponty argues that rather than being an object in the world, housing and controlled by the mind, the body is our means of communication with the world: It is permanently engaged with its environment. Arguing against the prevailing empiricist and rationalist views and following Husserl’s characterization of the body as the *nullpunkt*, Merleau-Ponty claims that this engagement is prereflective and necessarily from the perspective of the lived body: Spatiality is constituted through the body’s relation with its surroundings. He writes,

The word “here” applied to my body does not refer to a determinate position in relation to other positions or to external coordinates, but the laying down of the first coordinates, the anchoring of the active body in an object, the situation of the body in the face of its tasks. (Merleau-Ponty, 1945/2002, p. 115)

Hence, the human subject is an embodied subject, woven into the fabric of the world; it is inextricably and prereflectively in relation with the physical context in which it finds itself. As such, it is not the case that I find and experience my body first, and then employ it to explore the world. Rather, my body and the world are in an inextricable tangle, such that in matters of perception and experience one cannot be said to precede the other.

Additionally, Merleau-Ponty argues that it “is never our objective body that we move, but our phenomenal body” (p. 121). The lived body’s engagement with the physical world is not entirely conscious, but largely based on phenomenal prereflective experience. Faced with a pair of scissors, as a result of previously sedimented skills, I do not need to consciously reflect on their form and shape and come to some abstract conclusion about what they are for before I grasp them and begin to use them. The lived body does not move in a simply reflective and mechanical way, but rather engages intelligibly with the world—the space and objects in its proximity—in a prereflective and immediate manner:

The subject, when put in front of his scissors and needle and familiar tasks, does not need to look for his hands or his fingers, because they are not objects to be discovered in objective space ... but potentialities already mobilized by the perception of scissors or needle. (Merleau-Ponty, 1945/2002, p. 121)

Indeed, “My body has its world, or understands its world, without having to make use of my ‘symbolic’ or ‘objectifying function’” (Merleau-Ponty, 1945/2002, p. 162).

Furthermore, following Husserl, Merleau-Ponty argues that consciousness is necessarily intentional. Therefore, since the lived body *is* already consciousness, intentionality cannot be restricted to a cognitive act, but instead envelopes and involves the whole body. This bodily intentionality implies that through motility the lived body is permanently engaged in some physical situation: “My body appears to me as an attitude directed towards a certain existing or possible task” (Merleau-Ponty, 1945/2002, p.114).

Through this intentional attitude, the lived body has a constant and ever-changing relation to the physical objects and people in its proximity. However, it is important to understand that this physical relation to objects is not a discrete interaction: I do not engage with objects as though they were objects of the natural sciences. My physical interaction with objects and with other bodies can be described by the physical laws of science, but it cannot be reduced to that description.

The Transparent Body

Merleau-Ponty’s (1945/2002) account describes the phenomenological experience of the body as it is engaged with its surroundings in a prereflective and immediate manner. From the perspective of the performing subject, Merleau-Ponty and others argue that successful motor-intentionality induces a certain sort of bodily transparency where the body does not explicitly appear in the field of perception when it is intentionally directed to the world. In *L’être et le Néant* (1943),¹⁵ Jean-Paul Sartre (1943/1969) offers the example of writing to illustrate this phenomenological experience of bodily transparency. In the act of writing, he argues, “I do not apprehend my hand ... my hand has vanished” (Sartre, 1943/1969, p. 323). Of course Sartre does not mean this literally: My hand is still present while writing, and I *know* this, but I know it with a prereflexive type of awareness that does not involve regarding the body in a separative way, as an object of perception.

Shaun Gallagher (2004, p. 278) terms this the experience of the “absently available body.” He writes,

When the lived body is “in tune” with the environment, when events are ordered smoothly, when the body is engaged in a task that holds the attention of consciousness, then the body remains in a mute and shadowy existence and is lived through in a non-conscious experience. (p. 277)

In this sort of “successful” bodily experience, the body seamlessly facilitates the subject’s relation to the external environment and, as such, it is largely unnoticed or, to use Sartre’s (1943/1969, p. 330) oft quoted expression, “passed by in silence.” Implicit in this experience is a preconscious awareness of the position of the body and the ability to spontaneously move the body to act on the world without it “getting in the way.” Hence, in what many theorists categorize as “normal” or “healthy” functioning, there is no need for the subject to attentively perceive his or her own physical structure, and it remains the silent, tacit background to projects and interactions in the world.¹⁶

Another feature of bodily absence or transparency is that, in acts of action and volition, I also do not need to know how my body does something in order for me to do it successfully:

I do not need to know “how in the world I can do it” to perform Bodily activities. Research in physiology is indeed always possible when one adopts the appropriate natural-scientific attitude and method, but no knowledge of physiology is presupposed for me to make use of my powers of bodily movement in the “I will.” (Behnke, 2004, p. 243)

As Husserl (1952/1989, p. 297) indicates, “I execute my ‘*fiat*,’ and my hand moves.” But even when I explicitly will my body to perform a certain action, I rely on a silent and tacit bodily know-how, a general capacity to move responsively and coherently.

As a result, the lived body is not moved in a simply reflective nor mechanical way; for a majority of healthy and able-bodied adults, posture and movement occur without the need for conscious reflection. Therefore, when the lived body is functioning without interruption or distraction due to pain, fatigue, or other body occurrences, it engages with the world—the space and objects in its proximity—in a prereflective, albeit conscious, and immediate manner.¹⁷

Body Schema

The concept of the *body schema* is useful for understanding the automatic way in which one can move the body.¹⁸ Gallagher and Cole designate the body schema as a system of motor and postural functions that are in constant operation below the level of self-conscious intentionality: “Body schema can be defined as a system of preconscious, subpersonal processes that play a dynamic role in governing posture and movement” (1998, p. 131). The body schema makes it possible to move and control the body in a conscious and aware manner, without the need for deliberate and calculated intention.

Furthermore, the body schema not only regulates and controls the body’s posture and motility, but also how the body interacts with the objects and environment that constitute its immediate milieu. To illustrate this point, Merleau-Ponty (1945/2002, p. 175–176) gives the example of a blind man who uses a walking stick to aid in his maneuvering within the physical world. Over time, the blind man uses the stick as though it were an extension of his own body. His corporeal schema envelopes the stick: “Once the [blind man’s] stick has become a familiar instrument, the world of feel-able things recedes and now begins, not at the outer skin of the hand, but at the end of the stick.”

As an extension of the body schema, a tool such as the blind man’s stick is best understood as being incorporated within the perceived bounds of the body or “within the body’s focal disappearance” (Leder, 1990, p. 180). The tool modifies the intentional attitude of the lived body, expanding and transforming its scope of possible activity. Don Ihde (1990)

offers the example of eyeglasses, a simple technology that is absorbed by the body schema. The weight of the glasses on the ears and the bridge of the nose become imperceptible: “My glasses become part of the way I ordinarily experience my surroundings; they ‘withdraw’ and are barely noticed, if at all” (p. 73). The relation of mediation between “I-glasses-world” becomes “(I-glasses)-world” (p. 73). Additionally, as an object becomes part of the body schema, the subject modifies his or her actions to accommodate the extension:

A woman may, without any calculation, keep a safe distance between the feather in her hat and things which might break it off. She feels where the feather is just as we feel where our hand is. If I am in the habit of driving a car, I enter a narrow opening and see that I can ‘get through’ without comparing the width of the opening with that of the wings, just as I go through a doorway without checking the width of the doorway with that of my body. (Merleau-Ponty, 1945/2002, p. 165)

The subject, once familiar with an object, will interact and engage with it in a prereflective and preconscious manner, as though it were an extension of his or her own body. As an object is enveloped within the body schema, it modifies the intentional attitude of the lived body, expanding and transforming the scope of possible activity. Furthermore, the apparent transparency experienced by the body extends to the manipulated object. In the act of writing, as described by Sartre (1943/1969), it is not merely my hand that “vanishes,” but also the pen; it is to the writing where one’s perceptual attention is fixed.

The achievement of transparency in the case of manipulating a technological object is of particular interest in the case of telepresence. Inducing a sense of presence requires the receding of the mediating technology that transports awareness and motor-intentionality to the remote location. In VR, only when the head-mounted display, data gloves, and body suit, which enable the user to interact with the virtual environment, are absorbed by the body schema will a sense of presence be induced (Murray & Sixsmith, 1999, p. 318). Likewise in telepresence, mastery of the peripheral devices (i.e., joystick, hand controls, head display, etc.) will ensure a smoother engagement with the remote environment. With telesurgery and other telepresence activities, the subject, with sufficient skill and practice, should feel the controlling apparatus to be a seamless extension of his or her own physical body. Furthermore, as part of the corporeal schema, engagement with the object will occur in a seamless and prereflective manner, corresponding to the mediated sensory feedback that provides information about the remote environment.

It could be postulated that this interaction with the remote environment is a further extension of the corporeal schema. However, an interesting ambiguity arises in the case of remote manipulation, such as telesurgery: The device in the remote environment performing the action, for example a robotic surgical arm, is not a proximate extension of the surgeon’s physical body. However, it is clear that this apparatus is being directly manipulated by the surgeon’s motor-intentional actions and depends on the precise and skilled motor movements of a particular surgeon, not just the crude mechanisms of remote control, such as in the *Telegarden* or *Legal Tender*. The remote surgical system enables an expansion of the surgeon’s physical capabilities, abnegating the obstacles of distance. Hence, is it sensible to consider the remote device, the robotic apparatus, an extension of the surgeon’s corporeal schema?

This question must be considered carefully when regarding the characteristics of telepresence systems. Firstly, the doctor does not have a sense of the robotic arms in the same

way as I *know* the width of my car and the woman *knows* the length of her hat's feather due to their adjacency to the body. Indeed, a surgeon may never see the apparatus he or she is controlling, and furthermore will not have an embodied sense of the machine's dimensions and capabilities: Often visual feedback from a telesurgery system is magnified or modified in some way in order to facilitate minimally invasive procedures, where the scale of the procedure may be beyond the visual field encountered in open surgery (Wynsberghe & Gastmans, 2008, p. 3). In considering the limits of the corporeal schema, the example of telesurgery leads us to consider precisely what role proximity and scale play in the sense of ownership of action. Does it still make sense to say that *I* performed an action, or that a particular physical event as far away as France is from New York belongs to me?¹⁹

AGENCY AND OWNERSHIP OF ACTION

As was seen in the example of *Legal Tender*, doubt about ownership of action can cause a remote user to feel as though there is nothing physically at stake in the remote activity that is being performed. Despite the circumstances of *Legal Tender* being highly contrived and arguably incomparable to a phenomenon such as telesurgery, the philosophical issues that arise when considering telepresence systems such as *Legal Tender* and the *Telegarden* are still important to consider with respect to telesurgery. In the case of *Legal Tender*, the real remote environment accessed through telepresence becomes confused with a virtual environment, in which phenomena such as risk, responsibility, and interpersonal interaction, among others, do not have meaningful physical consequences. However, with the example of telesurgery, it is apparent that concrete physical consequences are fundamental for a successful surgical procedure. It is overwhelmingly pragmatic to ascribe ownership of action to the surgeon performing the operation, since there is a clear causal link between the user and the event, where a successful operation depends on the refined motor skills of a trained and practiced surgeon. However, despite conceptually ascribing ownership of action to the surgeon, phenomenologically it is important to establish whether the surgeon feels as though the actions observed through the visual feedback provided are his or her own; that is, whether a sense of presence, and hence an embodied sense of motor-intentionality in the remote environment, has been established. Indeed, establishing this sense of ownership is not only important for assigning responsibility and culpability, it is generally acknowledged by researchers in the areas of telepresence and VR that a sense of presence in a remote or virtual environment has a positive effect on task performance. It is argued that what is driving developments in presence technology is the "pervasive belief that presence is causally related to performance" (Welch, 1999, p. 574). Turning now to consider the issues of agency and ownership of action will elucidate a manner in which a qualitative distinction can be made between telepresence and normal actions, and begin to understand how an action can be felt as "mine" without necessarily having physical proximity.

While considering what constitutes the minimal self, Gallagher (2000) draws a useful distinction between agency and ownership. Gallagher writes that a *sense of agency* is the "sense that I am one who is causing or generating an action, for example, the sense that I am the one who is causing something to move" (p.15). In contrast, a *sense of ownership* is the "sense that I am the one who is undergoing an experience" (p. 15).²⁰ In normal action, where

volitional drives are in equilibrium with the external environment, Gallagher argues that, “the sense of agency and sense of ownership coincide and are indistinguishable” (p. 16).

However, agency and ownership of action are two phenomenologically distinct aspects of an experience. It is possible to have a sense of ownership of an action or movement without a sense of agency:

In the case of involuntary action ... I may acknowledge ownership of a movement—that is, I have a sense that I am the one who is moving or is being moved—and I can self-ascribe it as *my* movement, but I may not have a sense of causing or controlling the movement. (Gallagher, 2000, p. 16)

For example, when I am pushed on a crowded bus, or when a doctor picks up my arm to examine it, I do not provide any motive force for the movement; however, I experience the movement as belonging to me.

In contrast, there is a sense of agency in telepresence; that is, I sense that I am the one who is causing something to move or some event to happen. However, since I am not undergoing the experience of the action, I may not feel that it is necessarily mine. Dissociation from ownership, induced by a lack of presence, has many ethical and epistemological implications and, furthermore, has phenomenological consequences in which the subject feels alienated from the actions he or she is performing. Developments in telepresence technology that aim for high-fidelity telepresence, where interaction with the remote environment would be indistinguishable from interaction with reality, hope to induce a sense of bodily presence and ensure the coincidence of agency and ownership of action (Reintsema, Preusche, Ortmaier, & Hirzinger 2004). In effect, these technologies hope to create a sense of re-embodiment, displacing the motor-intentional behavior of the body without rupturing the phenomenological coincidence of agency and ownership. However, it will be seen that an understanding of the role of proprioception in motor-action will elucidate the limitations of the possibility of re-embodiment through telepresence.

PROPRIOCEPTION AND THE POSSIBILITY OF RE-EMBODIMENT

Proprioception is a term that has appeared in physiological, psychological, cognitive scientific, and philosophical literature, and has taken on various meanings.²¹ Proprioception is usually thought to include the kinesthetic and somatic sensations that permeate the body and give information regarding position, posture and movement. Gallagher explains,

Proprioception is the bodily sense that allows us to know how our body and limbs are positioned. If a person with normal proprioception is asked to sit, close his eyes, and point to his knee, it is proprioception that allows him to successfully guide his hand and find his knee. (2005, p. 43)

As Gallagher indicates, some theorists characterize the information given by these sensations as a form of conscious awareness, where we are said to be proprioceptively aware of limb position and movement. On the other hand, other theorists characterize proprioception as a subpersonal and nonconscious function, where the body processes the information given by proprioceptive and kinesthetic sensations without any need for conscious or reflective awareness.

Hence, Gallagher offers a distinction between “proprioceptive information” and “proprioceptive awareness” in order to elucidate the various levels of function. Proprioceptive awareness, Gallagher argues, involves an awareness of the body’s position but without the need for conscious perception (2005, p. 46). Proprioceptive information, by contrast, is information “generated at peripheral proprioceptors and registered at strategic sites in the brain ... [operating] as part of the system that constitutes the body schema” (Gallagher 2005, p. 46). Proprioceptive information consists of the somatic experiences that guide the body schema below the threshold of conscious experience. Hence, the aforementioned transparency of the body as experienced in successful intentional action is made possible by the body schema that uses proprioceptive information through proprioceptive awareness in order to correctly discern the posture and position of the body and the quality and aspect of motor movement.²²

Gallagher and Cole (1998) refer to the pathological case of Ian Waterman (IW), who, as a result of large fiber peripheral neuropathy, has lost the sense of touch and proprioception from the neck down. Despite suffering from almost total deafferentation, IW was not paralyzed and retains the ability to move his body. What is interesting about the case, however, is that at the onset of his illness, IW experienced a complete loss of motor and postural control, but did not experience paralysis. He had to painstakingly relearn how to move and perform everyday tasks by conceptualizing his movements and using visual cues about body position. For IW, even after relearning a repertoire of body skills, movement and posture require constant mental concentration and visual information (Gallagher, 2005, p. 43–45). He has lost the experience of body invisibility, which characterizes the normal and healthy experience of movement.

Hence, the importance of proprioceptive information in the successful operation of the body schema is made evident by the experience of IW and other deafferented cases (Cole & Paillard, 1995). Proprioceptive and tactile information within the body *and* the ability to feel and sense one’s own body are important for successful motor movement and perception. Proprioception is a fundamental element in the experience of agency and ownership of action. In fact, it is argued by theorists that the coincidence of proprioceptive sensations to visual feedback of motion is the mechanism that induces a sense of ownership of action (see, e.g., Martin, 1995). Indeed, Tsakiris and Haggard write, “Both action and body cues need to be integrated in order to generate the normal experience of will, agency and body-ownership that we entertain in our daily lives” (2005, p. 397). This phenomenon is confirmed by IW, who along with Jonathon Cole and Oliver Sacks, was “re-embodied” in a robot using telepresence technology at the Johnson Space Center in Houston, Texas:

The robot’s arms have joints that move like those of human arms, and three fingers on each hand. The arms are viewed by the human subject through a virtual-reality set placed over the eyes, with the robot cameras set in the robot’s “head” so that the subject views the robot arms from a similar viewpoint as one views one’s own arms. No direct vision of one’s own body is possible, while one sits across the room from the robot. A series of sensors are placed on one’s own arms, which in turn control the movement of the robot’s arms. Then when one moves, the robot’s arms move similarly, after a short delay. Thus one sees and controls the robot’s arms without receiving any peripheral feedback from them (but having one’s own peripheral proprioceptive feedback from one’s unseen arms)... Making a movement and seeing it effected successfully led to a strong sense of embodiment within the robot arms and body. This was manifest in one particular occasion when one of us thought that he had better be careful for if he dropped a wrench it would land on his leg! (Cole, Sacks, & Waterman 2000, p. 167)

The authors write that, “after a few minutes we all became at ease with the feeling of being ‘in’ the robot” and they hence suggest that the sense of ownership of our bodies and actions “is plastic and fragile” (Cole et al., 2000, p. 167).²³ Their experience leads them to suggest that ownership of action can be transferred to other bodies that provide visual feedback of motor movements that, to a large extent, matches the proprioceptive feedback within the body, even though the physical aspect of the new body, in this particular experience “a set of steel rods and stubby robotic [three-fingered] hands,” does not correspond to a human aspect (Cole et al., 2000, p. 167). However, the roughly anthropomorphic shape of the robot (in contrast to the myriad of forms that a body can take in a VR environment, e.g., an animal form such as a lobster or snake) may be what induces this correspondence of action. Indeed, it has been long argued in VR research that a visual and sensorial match of the virtual body to the human form is what induces a sense of embodied immersion (Murray & Sixsmith, 1999, pp. 325–326; Slater & Usoh, 1994).

Additionally, the experience of a sense of embodied risk mentioned by the authors suggests that it is possible to phenomenally have the sense that the physical body, and its concomitant concerns, can be transferred to a remote device. It is also interesting to note that this sense of risk arose even though the subject could not feel the weight of the wrench and despite a short time delay. Furthermore, IW, who lacks proprioceptive feedback and who participated in this experiment, also had the sense of being “re-embodied” in the robot. However, IW’s extensive re-training to move his body according to visual cues may account for this (Cole & Paillard, 1995).

Hence, it may be that with future technological developments that offer more replete sensory feedback, smaller time delays and a seamless matching of visual feedback to proprioceptive awareness, surgeons will increasingly feel as though they are actually physically present in the remote operating theater in which their motor movements have been displaced. An obvious benefit of inducing this sense of re-embodiment would be a seamless correspondence of agency and ownership of action, which would render issues such as epistemological doubt and responsibility, among others, meaningless, as well as enhance a sense of presence and, correspondingly, improve task performance. However, when considering the possibility of re-embodiment, Husserl’s (1952/1989, p. 167) claim that “I do not have the possibility of distancing myself from my Body, or my Body from me” must be thoughtfully examined.

Re-embodiment as envisioned under a philosophical paradigm such as the Cartesian-Lockian model would involve a shifting of the essential psychic component of the human subject from one mechanistically controlled physical body to another. However, as has been shown, the subject as a lived body, as described by Merleau-Ponty (1945/2002) and Husserl (1952/1989), is not merely a metaphysical entity encased arbitrarily within a physical substrate, but rather is composed of its material form and the intentional and volitional motor-movements that give it a meaningful existence.

Re-embodiment, therefore, would entail not merely a shifting of the visual sense to a remote body, providing observational access (as provided in early telepresence and VR technologies). Rather, re-embodiment, if we are to consider the essential phenomenological features of embodiment, would entail a transfer of the body schema, motor-intentionality, and perception, where successful intentional action would induce a transparency of not only the technological interface with which one engages, but also transparency of the body in the remote environment.

However, it must be remembered that one of the essential features of what constitutes a body, and differentiates it from other material objects, is its sentience, its capacity for sensation

and feeling. Yet, the body as a field of sensory experience is often left aside in phenomenological considerations of embodiment that are primarily concerned with intentionality. Indeed, Leder notes that, phenomenologists of the body, such as Merleau-Ponty, are “most interested in the phenomenology of perception and the functions of motility and expression with which it intertwines” (1990, p. 36). Leder proceeds to argue that the body as a unique field of sensory experience is often overlooked in phenomenological investigations.

These two aspects of the body, that is, the intentional body and the sensory body, are described in a distinction offered by Tsakiris and Haggard (2005, p. 389) between the “acting self” and the “sensory self.” The acting self is “the author of an action and also the owner of the consequent bodily sensations,” whereas the sensory self is “solely the owner of bodily sensations that were not intentionally generated, but ... passively experienced” (p. 389). Distinguishing between the acting self and the sensory self is useful in understanding the phenomenological characteristics of re-embodiment and to what extent the Husserlian (1952/1989, p. 167) idea of the body as an absolute here (*nullpunkt*) is challenged.

As has been demonstrated with Cole, IW, and Sack’s robot experience and the example of telesurgery, it is distinctly possible to displace the acting self. That is, it is possible to transfer bodily intentionality to a remote apparatus and have precise and skilled motor movements mirrored in a distant setting. The body schema is to some extent transferred to the remote apparatus, subject to modifications of scale and function.²⁴ Furthermore, the experience of a feeling of re-embodiment on the part of the user can be induced as a result of a high correspondence between visual and proprioceptive feedback. Hence, Husserl’s claim that the body “is a here which has no other here outside of itself, in relation to which it would be a ‘there’” is challenged by these particular types of experiences, as the acting self, immersed in a remote environment, is distanced from the sensory body (1952/1989, p. 166).

Hence re-embodiment, although possible in this limited sense, must be carefully qualified. The sensory body remains an absolute here, from which the acting self is displaced through the mediation of some sort of communications technology. Furthermore, the sensory body as an absolute here, located in a specific spatial and temporal context, cannot be distanced from itself, implying that even the most seamless experience of high-fidelity telepresence will remain qualitatively different from that of engagement with one’s immediate surroundings, since even though a sense of bodily risk in the remote environment may be induced, it will never be a reality. Stone (1992) argues this point, speaking of VR. She writes, “No refigured body, no matter how beautiful, will slow the death of a cyerpuck with AIDS. Even in the age of the technosocial subject, life is lived through bodies” (p. 113). Hence, if a fire breaks out in a distant operating theater, the surgeon manipulating the surgical apparatus from some remote location may receive sophisticated fire sensations through a sensory feedback device and feel an embodied sense of risk, but his or her skin will never suffer the risk of burn.

CONCLUSION: INTERCORPOREALITY AND THE “REAL” THING

As technological advances in telepresence become more pervasive in the day-to-day functioning of the modern world, a careful consideration of these technologies and their effects and implications must be undertaken. These technological advances have moved far beyond ordinary remote control and more sophisticated online experiments, such as *Legal Tender* and

the *Telegarden*, which explored the limits of epistemological concerns that arise in remote interactions. As has been demonstrated with the example of telesurgery, the phenomenological and philosophical issues that come as a result of embodied interaction in enriched telepresence, such as agency, ownership, the corporeal schema, and re-embodiment, transcend the Cartesian-Lockian paradigm for selfhood and can be understood with regard to the investigations of phenomenologists of the body such as Husserl, Merleau-Ponty, and their commentators. It has been argued that a sense of presence and re-embodiment can be provoked using technology that offers a high correlation between visual and proprioceptive feedback, maintaining a coincidence between agency and ownership. Furthermore, re-embodiment, in this sense, refers to a displacement of the acting self, distinct from sensory self, transferring the corporeal schema and motor-intentions to a remote environment. As has been shown, a reconsideration of the body as an “absolute here” is necessary in order to adequately account from these experiences arising from distinct social and cultural developments.

While advances in technology continue at a rapid rate, taking telepresence devices to previously unimagined levels of sophistication, it is not surprising that one of the prevailing questions among the technological and philosophical communities engaged in the developments of this technology is whether remote interaction will really ever be as good as the “real thing.” Even the most sophisticated technological interface, which would provide seamless multisensory feedback inducing a flawless sense of presence, could not, as has been discussed, compensate for the lack of embodied risk. However, it is not merely a lack of bodily risk that poses what at present seems like an insurmountable qualitative difference between the experiences provided by telepresence and VR as compared to real-world interaction.

A further important element overlooked in the Cartesian-Lockian model of selfhood, and hence in the technological developments made under this paradigm, is the importance of intercorporeal relations. Indeed, recent developments in telepresence, artificial intelligence, and VR technology have recognized the fundamental need to take into account bodily interactions, such as communication through gestures, expression, and other body cues in order to accurately reflect interpersonal human interaction and hence make these technologies user-friendly and successful (Canny & Paulos, 2000). Physical contact and proximity between human subjects constitutes an important qualitative aspect of intersubjective relations that may never be obviated by technological mediums. As Dreyfus writes, “Even the most gentle person/robot interaction would never be a caress, nor could one use a delicately controlled and touch sensitive robot arm to give one’s kid a hug. Whatever hugs do for people, I’m sure telehugs won’t do it” (2000, p. 62). This leaves us to ponder if the aims of these technological developments should be to ultimately replicate the real thing, or whether we should regard telepresence as a distinct experience in its own right, with its own set of phenomenological characteristics. Indeed, it is hard to imagine that the comfort and reassurance brought about by the simple physical presence and contact of one’s own doctor will ever be induced in a remote interaction, no matter how refined the surgical and medical expertise provided.

ENDNOTES

1. The term *telepresence* was originally coined in 1980 by Marvin Minsky, who applied it to remote object manipulation applications and their teleoperation systems (Campanella, 2000).
2. Descartes considered the mind to be connected to the body and the outside world in a mediated manner. He writes that “the mind is not immediately affected by all parts of the body, but only by the brain, or perhaps just by one small part of the brain” (Descartes, 1996, p. 59).
3. The phenomenology of embodiment in virtual reality systems has received theoretical attention from several theorists (see, in particular, Ihde, 2002; Murray, 2000; Murray & Sixsmith, 1999).
4. Campanella describes the varieties of telepresence as “low telepresence,” as afforded by a webcam, and “high telepresence,” which involves “a transparent display system” and “multiplicity of feedback channels.” In addition, he describes mediums that give some degree of “telerobotic interactivity” (Campanella, 2000, pp. 27–30). It is from Campanella framework that I have schematized the four distinct types of telepresence.
5. See <http://www.counterfeit.org>
6. See <http://www.telegarden.org/tg/>
7. See United States Code, Title 18, Section 333, “Mutilation of national bank obligations,” available at http://www.law.cornell.edu/uscode/html/uscode18/usc_sec_18_00000333----000-.html
8. For further discussion of telepistemology, see Goldberg (2000).
9. There are three leading surgery systems currently used by surgeons in the USA and Europe. They are the Da Vinci Surgical System, ZEUS Robotic Surgical System, and the AESOP Robotic System (Bonsor, 2000).
10. Furthermore, Dr. Mehran Anvari, a Canadian telesurgeon, has performed more than two dozen remote surgeries on patients who were up to 250 miles away (Fleming-Michael, 2006).
11. When quotations are drawn from the translated foreign-language texts, it is traditional in the discipline of philosophy to provide page references for both the original text and the translation. In the APA notation system, however, that becomes quite convoluted. Therefore only the translation pages are cited, but the original text was investigated for each point. In this case, the original text is Husserl (1952).
12. The distinction between the body as a physical object and the body as a living organism is reflected in Husserl’s use of the German terms *Körper* and *Leib*. *Körper*, etymologically related to the English word *corpse*, is understood to mean “inanimate physical matter,” and refers to the materiality of the body, that is, the body as a physical object extended in space. *Leib* refers to “the animated flesh of an animal or human being” and is usually translated as *lived body*, carrying in this meaning the complexity of the experiential and subjective aspects of the body. In the “Translator’s Introduction” in *Ideas II* (Husserl, 1989, p. xiv), these are distinguished orthographically, with *Leib* appearing as “Body” and *Körper* as “body” (I will preserve this distinction in citations, but I will not use it myself).
13. Again, while only the translation is cited here, Merleau-Ponty’s (1945) original text in French was consulted.
14. For a discussion of specific innovations Merleau-Ponty made to Husserl’s description of embodiment, see Smith (2007).
15. Sartre’s (1943) original text in French was consulted, although just the English translation is cited here.
16. Phenomenological corporeal absence is taken up by Drew Leder (1990) in his work *The Absent Body*, where he explores the fact that while “in one sense the body is the most abiding and inescapable presence in our lives, it is also essentially characterized by absence” (p. 1).
17. It must be acknowledged that the intentional relation to the world and the apparent transparency of the body can be disrupted as a result of disability, pain, illness, and other routine and periodic bodily occurrences, such as pregnancy and menstruation. In these cases, a seamless perceptual and intentional relation to the external milieu can be disrupted or modified and the

body is brought to one's attention. Instead of flawlessly facilitating a relation to the external world, the body can "get in the way," so to speak. Sartre (1943/1969, p. 331–332), again, offers an example: When I am reading, I am not aware of my eyes. It is only when my eyes start hurting that I become aware of them and realize that it is in fact my eyes that stand between me and the page. Many theorists agree that the body usually is noticed only in instances in which, for example, it breaks down, fails, or loses equilibrium with its surroundings (see, e.g., Gallagher, 2005). They argue that, in normal circumstances, the body remains absent to consciousness unless there is a forced reflection brought on by some sort of pain or discomfort. As might be expected, this characterization of the normal body as one that does not suffer from disability, pain, and inevitable body occurrences such as pregnancy and menstruation has come under criticism from disability and feminist theorists (see Leder, 1990).

18. There is some confusion about the term *body schema* in the English translation of *Phénoménologie de la Perception*. Merleau-Ponty (1945) uses the term *schéma corporel* (body schema), although it is regularly translated by Colin Smith (Merleau-Ponty, 1945/2002) as *body image*. (See, for example, Merleau-Ponty, 1945/2002, p. 113.)

19. See Dennett (1981) for a thought experiment that discusses the issue of responsibility with respect to remote action.

20. *Ownership* in this case refers to ownership of action, rather than body ownership. See Martin (1995) for a discussion of body ownership.

21. For a discussion of these various meanings see Gallagher (2003). Furthermore, it is important to note that proprioception is a term used by Merleau-Ponty (1945) in the *Phénoménologie de la Perception*, although it is lost in Colin Smith's English translation (Merleau-Ponty, 1945/2002). For example, Smith translates Merleau-Ponty's original French text: "On entendait d'abord par «schéma corporel» un *résumé* de notre expérience corporelle, capable de donner un commentaire et une signification à l'interoceptivité et à la proprioceptivité du moment" (1945, p. 128) to the following English passage: "'Body image' was at first understood to mean a *compendium* of our bodily experience, capable of giving a commentary and meaning to the internal impressions and the impression of possessing a body at any moment" (1945/2002, p. 113). In Smith's English translation of the French original, it can be seen that proprioceptivity [proprioceptivité] has been rendered the "impression of possessing a body," which loses much of the significance of the original term.

22. Vestibular and other information from the body's systems also inform the body schema (see Gallagher, 2005, p. 47).

23. The authors suggest that a possible reason for this plasticity with regard to ownership of the human body results from the fact that, during a lifetime, the body will alter significantly, from infancy to old age or due to illness or accident. They write, "Corporeal changes must be assimilated. If we did not have this ability to alter our mapping of a sense of ownership and of agency onto altered bodies we might be at risk of alienation from them" (Cole et al., 2000, p. 167).

24. The development of PRoPs (Personal Roving Presence Device) as remotely controlled robotic devices that can be present in a remote environment exemplify the transferral of the body schema and this notion of re-embodiment of the acting self. They are intended to provide "the ultimate prosthetic" or a "full body replacement," a user can interact with other PRoPs or real human subjects in a distant environment, ultimately incorporating body cues such as "gaze, back channelling [and] posture" (Canny & Paulos, 2000, pp. 280, 278).

REFERENCES

- Behnke, E. (2004). Edmund Husserl's contribution to phenomenology of the body in *Ideas II*. In D. Moran & L. E. Embree (Eds.), *Phenomenology: Critical concepts in philosophy* (Vol. II; pp. 235–264). Oxon, UK: Routledge.
- Bonsor, K. (2000). How robotic surgery will work. Retrieved April 4, 2009, from the How Stuff Works Website, <http://electronics.howstuffworks.com/robotic-surgery.htm>

- Campanella, T. J. (2000). Eden by wire: Webcameras and the telepresent landscape. In K. Goldberg (Ed.), *The robot in the garden: Telerobotics and telepistemology in the age of the Internet* (pp. 22–45). London: MIT Press.
- Canny, J., & Paulos, E. (2000). Tele-embodiment and shattered presence: Reconstructing the body for online interaction. In K. Goldberg (Ed.), *The robot in the garden: Telerobotics and telepistemology in the age of the Internet* (pp. 276–295). London: MIT Press.
- Cole, J., & Paillard, J. (1995). Living without touch and peripheral information about body position and movement: Studies with deafferented subjects. In J. L. Bermudez, A. Marcel, & N. Eilan (Eds.), *The body and the self* (pp. 245–266). London: MIT Press.
- Cole, J., Sacks, O., & Waterman, I. (2000). On the immunity principle: A view from a robot. *Trends in Cognitive Sciences*, 4, 167.
- Dennett, D. C. (1981). Where am I? In *Brainstorms: Philosophical essays on mind and psychology* (pp. 310–333). London: Penguin.
- Descartes, R. (1996). Sixth meditation. In J. Cottingham (Ed.), *Meditations on first philosophy: With selections from the objections and replies* (pp. 50–62). Cambridge, UK: Cambridge University Press.
- Dreyfus, H. (2000). Telepistemology: Descartes's last stand. In K. Goldberg (Ed.), *The robot in the garden: Telerobotics and telepistemology in the age of the Internet* (pp. 48–63). London: MIT Press.
- Fleming-Michael, K. (2006). Researchers make progress with robotic telesurgery. Retrieved April 4, 2009, from the U.S. Army News Service Website, <http://www.military.com/features/0,15240,97023,00.html>
- Gallagher, S. (2000). Philosophical conceptions of the self: Implications for cognitive science. *Trends in Cognitive Sciences*, 4, 14–21.
- Gallagher, S. (2003). Bodily self-awareness and object perception. *Theoria et Historia Scientiarum: International Journal for Interdisciplinary Studies*, 7, 53–68.
- Gallagher, S. (2004). Lived body and environment. In D. Moran & L. E. Embree (Eds.), *Phenomenology: Critical concepts in philosophy*. (Vol. II; pp. 265–293). Oxon, UK: Routledge.
- Gallagher, S. (2005). *How the body shapes the mind*. Oxford, UK: Oxford University Press.
- Gallagher, S., & Cole, J. (1998). Body image and body schema in a deafferented subject. In D. Welton, (Ed.), *Body and flesh: A philosophical reader* (pp. 131–148). Oxford, UK: Blackwell.
- Goldberg, K (Ed.). (2000). *The robot in the garden: Telerobotics and telepistemology in the age of the Internet*. London: MIT Press.
- Hanly, E., & Broderick, T. (2005). Telerobotic surgery. *Operative Techniques in General Surgery*, 7, 170–181.
- Husserl, E. (1952). *Ideen zu einer reinen Phänomenologie und Phänomenologischem Philosophie. Zweites Buch: Phänomenologische Untersuchungen zur constitution* [Ideas pertaining to a pure phenomenology and to a phenomenological philosophy: Second book] (Marly Biemel, Ed.). The Hague, the Netherlands: Martinus Nijhoff.
- Husserl, E. (1989). *Ideas pertaining to a pure phenomenology and to a phenomenological philosophy: Second book* (R. Rojcewicz & A. Schuwer, Trans.). Dordrecht, the Netherlands: Kluwer. (Original work published in 1952)
- Ihde, D. (1990). *Technology and the lifeworld: From garden to Earth*. Bloomington, IN, USA: Indiana University Press.
- Ihde, D. (2002). *Bodies in technology*. Minneapolis, MN, USA: University of Minnesota Press.
- Leder, D. (1990). *The absent body*. Chicago: University of Chicago Press.
- Malpas, J. (2000). Acting at a distance and knowing from afar: Agency and knowledge on the Internet. In K. Goldberg (Ed.), *The robot in the garden: Telerobotics and telepistemology in the age of the internet* (pp. 108–125). London: MIT Press.
- Marescaux, J., Leroy, J., & Rubino, F. (2002). Transcontinental robot assisted remote telesurgery: Feasibility and potential applications. *Annals of Surgery*, 235, 487–492.
- Martin, M. G. F. (1995). Bodily awareness: A sense of ownership. In J. L. Bermudez, A. Marcel & N. Eilan (Eds.), *The body and the self* (pp. 267–289). London: MIT Press.

- Merleau-Ponty, M. (1945). *Phénoménologie de la perception* [Phenomenology of perception]. Paris: Editions Gallimard.
- Merleau-Ponty, M. (2002). *Phenomenology of perception* (C. Smith, Trans.). New York: Routledge. (Original work published in 1945)
- Murray, C. D. (2000). Toward a phenomenology of the body in virtual reality. *Metaphysics, Epistemology and Technology*, 19, 149–173.
- Murray, C. D., & Sixsmith, J. (1999). The corporeal body in virtual reality. *Ethos*, 27, 315–343.
- Reintsema, D., Preusche, C., Ortmaier, T., Hirzinger, G. (2004). Toward high-fidelity telepresence in space and surgery robotics. *Presence*, 13, 77–98.
- Sartre, J. P. (1943). *L'être et le néant: Essai d'ontologie phénoménologique* [Being and nothingness]. Paris: Editions Gallimard.
- Sartre, J. P. (1969). *Being and nothingness* (H. E. Barnes, Trans.). London: Methuen. (Original work published in 1943)
- Satava, R. M. (2005). Telesurgery, robotics and the future of telemedicine. *European surgery*, 37, 304–307.
- Silverman, R. D. (2003). Current legal and ethical concerns in telemedicine and e-medicine. *Journal of Telemedicine and Telecare*, 9, 67–69.
- Slater, M., & Usoh, M. (1994). Body centered interaction in immersive virtual environments. In N. M. Thalmann & D. Thalmann (Eds.), *Artificial life and virtual reality* (pp. 125–147). Chichester, UK: John Wiley.
- Smith, A. D. (2007). The flesh of perception: Merleau-Ponty and Husserl. In T. Baldwin (Ed.), *Reading Merleau-Ponty: On phenomenology of perception* (pp. 1–22). London: Routledge.
- Steuer, J. (1995). Defining virtual reality: Dimensions determining telepresence. In F. Biocca & M.R. Levy (Eds), *Communication in the age of virtual reality* (pp. 33–56). Hillsdale, NJ, USA: Laurence Erlbaum Associates.
- Stone, A. R. (1992). Will the real body please stand up?: Boundary stories about virtual cultures. In M. Benedikt (Ed.), *Cyberspace: First steps* (pp. 81–118). Cambridge MA, USA: MIT Press.
- Tsakiris, M., & Haggard, P. (2005). Experimenting with the acting self. *Cognitive Neuropsychology*, 22, 387–407.
- van Wylsberghe A., & Gastmans, P. (2008). Telesurgery: An ethical appraisal. *Journal of Medical Ethics*, 34(10), e22.
- Welch, R. B. (1999). How can we determine if the sense of presence affects task performance? *Presence*, 8, 574–577.

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