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TECHNOLOGY AND EMBODIMENT IN IHDE AND MERLEAU-PONTY

There is a special class of artifacts, that includes telescopes, probes, hearing aids, and similar items, that are capable of engaging in 'symbiotic' relationships with the human body. These artifacts are not normally perceived and acted on as objects in one's environment, but instead are used as means through which the environment is experienced and acted on. Glasses and hearing aids, when worn, are not normally encountered as objects in the environment, the are means through which the environment is perceived. Likewise, a blind man's cane or a dentist's probe are means through which the environment is perceived and acted on. Don Ihde has called the special relations between human beings and such artifacts *embodiment relations*, since such artifacts seem to become part of our embodiment. In contrast, most objects in the environment, including trees, tables, and vases, may well function as objects of perception and action, but do not normally function as objects through which the environment is perceived and acted on.

From an epistemological point of view, embodiment relations are interesting in several ways. First, perception through embodied instruments like microscopes and telescopes raises epistemological questions. Such perception differs from unaided perception in that the original sensory information has been pre-processed (e.g., augmented or distorted) by a technological device. The nature and reliability of technologically mediated perception has already become an important issue in the philosophy of science, in which it is part of epistemological studies of scientific instrumentation (e.g., Hacking, 1983; Ihde, 1991; Brown, 1990).

Second, our cognition of embodied artifacts themselves is puzzling. We often do not seem to be consciously aware of them, since after an initial habituation period, they fade into the background of our awareness. Yet, the skillful use we make of them reveals that we possess detailed information about them, for instance about their location in space. How is this information gained and represented? This question is especially interesting since it appears that our knowledge of embodied artifacts in some ways seems to resemble our knowledge of body parts. Some

philosophers (e.g., Wittgenstein, Anscombe) have argued that we have a special way of knowing about (the position of) our body that is not gained by ordinary sensory perception. An analysis of how embodied artifacts are known may hence also sharpen our understanding of the different ways in which we are acquainted with our own body.[1]

An understanding of embodiment relations may moreover be relevant to philosophical anthropology and the philosophy of action. Embodied artifacts change our relation to the world, sometimes even profoundly. The microscope, for example, has forever changed the way we understand our world, and the telephone has had an impact on our awareness of place. Embodiment relations are relevant to the philosophy of action, finally, because many human actions are nowadays mediated by technology, and a proper analysis of technologically mediated action requires an understanding of how technical artifacts that participate in embodiment relations constrain and facilitate action.

So far, few studies of embodiment relations have appeared. Don Ihde's account of them is probably the most sustained account that currently exists. In this essay, I will assess Don Ihde's account of embodiment relations. I will argue that Ihde's account is too limited to serve as a full-blown account of embodiment relations, as it takes as its task the description of recurrent patterns of experience found in embodiment relations, without also explaining how embodiment relations are constituted. This limitation, I will argue, leads Ihde to construe embodiment relations as perceptual, whereas I will argue that they also frequently also behavioral. Moreover, Ihde is claimed to compound two kinds of experience found in embodiment relations: experiences of the world as perceived through embodied artifacts, and proprioceptive 'experiences' or representations of the location and orientation of embodied artifacts. The expanded account of embodiment relations that I will end up presenting is directly based on Maurice Merleau-Ponty's original theory of embodiment relations, published in the nineteen forties, on which Ihde's account is also partially based.

1. Ihde on embodiment relations

Don Ihde is well known for his theory of human-technology relations (Ihde, 1979, 1990). The aim of this theory, presented in different versions over the years, is to account for the various ways in which technology plays a role in human experience. As Ihde puts it, the goal of his theory is to 'show what is invariable in the way

humans experience their technologies' (1993, p. 111). In other words, his theory aims to describe certain patterns of experience that recur in different ways in which humans interact with technology. A taxonomy of recurrent patterns of experience would then amount to a taxonomy of human-technology relationships, as these can be distinguished from a phenomenological point of view.

Ihde (1990) distinguishes different types of human-technology relations. Embodiment relations constitute one important type of human-technology relation, in which artifacts are experienced as means through which one's environment is encountered. Ihde defines embodiment relations as uses of technologies in which the technology mediates one's experience of one's environment or world, by being a medium positioned in between individual and world *through* which the individual perceives her world. In Ihde's words, in a embodiment relation 'I take the technologies *into* my experiencing in a particular way by way of perceiving *through* such technologies and through the reflexive transformation of my perceptual and body sense.' (1990, p. 72). In embodiment relations, the embodied technology does not, or hardly, become itself an object of perception. Rather, it 'withdraws' and serves as a (partially) transparent means through which one perceives one's environment, thus engendering a partial symbiosis of oneself and it. As prototypical examples of technologies that are often if not primarily used in embodiment relations, Ihde mentions such items as glasses, telescopes, hearing aids, dentist's probes, and a blind man's cane. These items are artifacts that 'withdraw' when used, and serve as semi-transparent means through which one's environment is perceived.

Whereas the previously mentioned artifacts make a good fit with Ihde's definition of an embodiment relation, Ihde also mentions examples of embodiment relations that seem to fit his definition less well. For example, Ihde also identifies the use of a hammer as involving an embodiment relation (1990, p. 80). However, a hammer is clearly not an instrument that is used, like telescopes and dentist's probes, to (better) perceive aspects of one's world. Instead, it is an instrument to act on the world. Ihde may submit, however, that tools like hammers nevertheless transmit perceptual feedback about the world. As the hammer hits a surface, one may feel aspects of that surface through the hammer. These perception may be used, in turn, to better guide the blows of the hammer. So although hammers are not primarily tools for perception, it may be argued that they nevertheless serve to mediate perception and in this sense fit Ihde's definition of an embodiment relation.

Other examples presented by Ihde, however, are still more problematic. Two of these, involving a feathered hat and a car, are quoted by Ihde from Merleau-Ponty's *Phenomenology of Perception*: I will here cite from Merleau-Ponty's text:

> A woman may, without any calculation, keep a safe distance between the feather in her hat and things which might break if 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 against that of my body. The hat and the car have ceased to be objects with a size and volume which is established by comparison with other objects. They have become potentialities of volume, the demand for a certain amount of free space (Merleau-Ponty, 1962, p. 143).

In the example involving the feathered hat, the feather on the woman's hat is embodied in the sense that the woman has a tacit knowledge of the location of her feather, just like she has a tacit knowledge of the location of her hands. However, the feather is clearly not a medium through which the woman perceives and recognizes aspects of her environment. It is not used, like a blind man's cane, to extend tactile perception (although it could perhaps be used in this way), as the woman in fact tries to avoid contact between her feather and things in her environment. Similarly, although the driver of a car may have a tacit understanding of the location of the car relative to structures in the environment, it is not normally the case that the driver can feel these structures through the chassis of the car. So it appears that these examples do not fit Ihde's definition of an embodiment relation.

It appears, then, that there is a tension in Ihde's work between different notions of an embodiment relation. It is my aim here to resolve this tension. This tension can be resolved, I will argue, by considering the original account of embodiment relations developed by Merleau-Ponty. Not only was Merleau-Ponty the first author to present a theory of embodiment relations,[2] Merleau-Ponty is also responsible for most of the examples discussed by Ihde that do not seem to fit Ihde's definition of an embodiment relation. Hence, a study of the way Merleau-Ponty conceived of embodiment relations is likely to be revealing. My discussion of Merleau-Ponty's views on embodiment relations will result in an extended theory of embodiment relations, that accomodates embodiment relations that fit Ihde's definition of an embodiment relation, but that also recognizes other kinds of embodiment relations.

2. Merleau-Ponty's theory of embodiment relations

Maurice Merleau-Ponty's *Phenomenology of Perception* is not, like Ihde's work, primarily concerned with technology, but rather with the nature of the human body and of perception. There are only a few brief passages in Merleau-Ponty's work in which human-artifact relations are discussed.[3] The discussion of human-artifact relation in these passages occurs within the context of a discussion of skills, which in turn is part of Merleau-Ponty's account of the human body. Although brief, these passages are highly suggestive, and constitute, I claim, a proto-theory of embodiment relations. In what follows, I will try to give a brief statement of this proto-theory. Such a statement needs to be preceded, however, by a basic exposition of Merleau-Ponty's account of the human body and its world, and of perceptual and motor skills. Needless to say, Merleau-Ponty's views on these matters cannot be done full justice here. My account of these matters will necessarily be sketchy, and involve a good deal of interpretation.

Perhaps the main idea developed in the *Phenomenology of Perception* is that, experientially, there is a fundamental difference between one's body and objects located outside one's body in the external environment. The external world is experienced as a spatial structure, in which things are, relative to us, remote or near, high or low, or to the right or to the left. The body, however, is not normally experienced as a spatial entity of the kind found in one's external environment. The circumference of one's body, as it is experienced by one, forms a boundary within which one is not normally aware of spatial relations. There are, admittedly, exceptions to this rule. It is certainly possible to experience one's body in spatial terms, and one can, for example, experience one's arms as being positioned above one's legs, or one's hand as being closer to one than the table. In such cases, one experiences the body as a physical structure just like other physical structures. However, in everyday actions, one does not normally experience the body as a physical, spatial structure in the external world. Instead, one experiences the body as a not expressly spatial means by which the spatial world is engaged. Moreover, although one may be aware of the relations between different parts of one's body, these relations are not normally understood as spatial relations.

This still sounds quite mysterious. So let us consider a hopefully revealing analogy. Suppose one is wearing a pair of glasses with red lenses. Now, one certainly has an experience of these red lenses, as they make the whole world appear red. However, as one looks through them, one does not experience them as located at some definite location in the world that one sees through them (unless, of course, one

looks into a mirror). These lenses are hence means by which one engages the world, but not, in one's normal experience, objects that are spatially located in that world! Suppose, moreover, that on these glasses, right above the red pair of lenses, a second, green pair of lenses has been attached. The location of these two pairs of lenses is moreover controlled by a refined mechanism, attached to the muscles surrounding one's eyes, such that when one squints, both pairs of lenses lower two inches, so that one now looks through the green lenses. When one stops squinting, the lenses rise again, so that one looks through the red lenses again. Now, the relation between the red lenses and the green lenses is not normally experienced by the wearer of these glasses as a spatial relation (unless she looks into the mirror and sees the green lenses being located two inches above the red ones). Instead, the relation between the red and green lenses is experienced in terms of the motor acts of squinting and leaving off squinting.

The analogy is that one's body is, just like the red lenses, a medium through which one engages the world, that is not normally experienced as a spatial entity. Moreover, just like the relation between the red and green lenses is not normally experienced as a spatial relation, the relation between different parts of one's body is not normally experienced as a spatial relation, but instead as a relation defined in terms of motor acts, which are again themselves not experienced as activities located in space. For example, when one is laying on one's right arm, the relation between one's torso and one's right arm is not primordially experienced as one's torso being above one's right arm, but as a dependency relation in which the ability of one's right arm to act is dependent on moving one's torso so as to free one's right arm. As Merleau-Ponty puts it, one's body is a 'potentiality of movement,' or a 'field of possibilities of interaction with the environment,' a structure whose parts are understood in terms of their ability to enter into one's projects, rather than in terms of their spatial location.

Still, Merleau-Ponty does not want to say that it makes no sense at all to say that one's body parts are in space. The body is, in a sense, spatial, but the space inside the body is not an ordinary space like the one experienced external to the body. Instead, it is a space in which spatial relations are 'motor relations'. For example, the relation between an outstretched hand and a fist is not understood in terms of ordinary spatial relations, but in terms of the motor primitives of clenching and opening wide. Merleau-Ponty calls the space of the body a 'space of situation' which contrasts with the 'space of position' of the external world (1962, pp. 98-102).

According to Merleau-Ponty, one's body is immediately known to one by means of a *body schema*, or *body image*.[4] The body schema is an organizing structure contained

in one's body that presents one with a unified understanding of one's body, which is experienced as a unified whole or 'Gestalt'. The body schema moreover provides one with a pre-reflective, immediate knowledge of the position of one's body parts. This position is again found in what Merleau-Ponty calls the 'space of situation' and not the 'space of position.' When one sees a glass on the table, one may unthinkingly grasp it with one's hand, guided by one's body schema that knows that one's hand can grasp things, automatically localizes one's hand, and guides it to the glass. Although the body schema makes the positions of one's body parts immediately known to one, it is not a mere composite of experiences of one's body parts, but rather a structure that precedes such experiences, as the existence of phantom limbs shows.

The body schema is a dynamic structure that reveals the body's orientation not just towards existing but also towards possible tasks. Moreover, the equivalencies between these different orientations, and the trajectories to follow to move from one orientation to the next, are immediately known through the body schema. For example, one knows through one's body schema how one's limbs when one is in upright position correspond with one's limbs when one is crouched, and how to move between these two positions. Similarly, one knows by one's body schema whether one is able to walk through a doorpost without bowing, because one's body schema immediately tells one how one's body relates to the doorpost. The body schema does so without assigning a spatial position to the body, because the body does not need to be oriented in space, as it is the anchor relative to which other objects are oriented.

The potentialities of the body schema also determine aspects of the external world, as they are experienced. They determine, for example, whether things count as near or far away, large or small, heavy or light, high or low, passable or impassable, within reach or out of reach, hard or soft, warm or cold, being built up out of two colors or four colors. The space in which the body orients itself is hence not a Euclidean space containing things with objective properties, but a subjective, meaningful space, whose features, that the body has assigned meanings as possibilities for movement.[5]

Although the body schema contains invariant elements, not all its potentialities are permanent features of it. The body schema can be changed, by the acquisition of new possibilities for movement. A possibility for movement that can be thus acquired, Merleau-Ponty calls a *habit*, or *skill*.[6] A skill, when acquired, hence alters the body schema by altering its potentialities for action. For example, when the child learns to grasp physical objects, or to jump fences, its learns new motor transformations and equivalents that change its body schema. Note that Merleau-

Ponty does not just recognize the existence of *motor skills*, but also recognizes *perceptual skills*, such as being able to discriminate yellow from green.[7] As the body schema changes, experienced properties of one's environment change along with it. For example, a fence that was at first unscalable, or colored yellow-green, may now be scalable, and colored yellow and green.

Most skills that are acquired are perceptual and motor skills by which one orients oneself to aspects of one's environment. Such skills relate positions or acts of one's own body to each other, as when one learns to dance, scale fences, or discriminate between blackberries and blueberries. Some skills, however, involve learning to handle objects that are used as tools, or that are otherwise attached to one's body, as when one learns to see through a microscope, to balance a clay jar on one's head, or to cut paper with scissors. According to Merleau-Ponty, when one learns the skill of 'handling' such an object, what happens is that this object becomes incorporated into one's body schema. It is then experienced and used as part of the means by which one engages the world, rather than as an object in the world that one engages. It becomes a means through which skills are expressed, rather than an object of skilled action. As such, it comes to function as direct extensions of ourselves, as an integral part of our body. In this way such artifacts differ fundamentally from artifacts that are not incorporated into the body schema, like the door one opens, the nail one hammers, the light one switches on, and the roof above one's head.

Merleau-Ponty gives at least five examples of such embodiment relations, involving uses of a feathered hat, a car, a blind man's stick, a typewriter and an organ. The examples of the feathered hat and car were already presented. For now, I will present one more:

> When the typist performs the necessary movements on the typewriter, these movements are governed by an intention, but the intention does not posit the keys as objective locations. It is literally true that the subject who learns to type incorporates the key-bank space into his bodily space (1962, p. 145)

The skilled typist embodies the typewriter so that it becomes a direct extension of his hands. An unskilled typist, in contrast, fails to incorporate the keyboard into his bodily space, and has to search for each key in space. Every touch of a key then becomes an encounter with the keyboard, instead of an act that incorporates the keyboard. The boundary between subject and world remains positioned at the end of the subject's hands, and is not extended to incorporate the keyboard.

3. Motor and perceptual embodiment

The three examples of embodiment relations presented by Merleau-Ponty that have been discussed so far, involving a feathered hat, car, and typewriter, are not examples in which the (primary) function of the artifact is to mediate perception. They are not brought up by Merleau-Ponty in a discussion of perception, but in a section on motor skills. Merleau-Ponty's named distinction between perceptual skills and motor skills leads to a distinction between two types of embodiment relations, being two ways in which an artifact may be integrated into the body schema. An artifact may either become a means through which motor skills are expressed or a means through which perception takes place. Combinations are possible, and frequent, as well: an artifact may mediate both motor skills and perceptual skills, although in most cases, one type of skill will dominate.

The class of embodiment relations defined by Ihde can, in terms of Merleau-Ponty's theory, be identified as embodiment relations in which an artifact becomes part of the body schema by becoming a medium through which *perceptual skills* are expressed. Perceptual skills such as the skill of being able to discern color or pitch, to identify spatial relations and to detect motion are then exercised through the artifact. Three of the senses can be mediated in this way: sight, hearing, and feeling. Optical instruments like telescopes, microscopes, and glasses mediate visual perception. Aural instruments like hearing aids and stethoscopes mediate hearing. Finally, tactile instruments like probes and blind man's canes serve to mediate tactile perception.

Artifacts that mediate *motor skills* become part of the body schema by becoming a medium through which motor skills are expressed. There appear to be at least two ways in which artifacts mediate motor skills. First, artifacts may be appendages to one's body with which, or by which, one moves through one's environment. I will call the motor skills this requires *navigational skills*. The feathered hat and the automobile constitute examples of such appendages. They serve to enlarge one's body, and this enlargement has to be taken into account as one navigates through one's environment. Other examples of such artifacts include a worn backpack, a bicycle one rides, a plank one carries on one's shoulder, and any hand-held object that one carries around. As these artifacts become incorporated into one's body space, one knows tacitly and immediately where they are in relation to objects in one's environment, and one is able to navigate them through the environment. Usually, the goal of navigation is to avoid collision with objects in one's environment as one attempts to reach a desired destination along a chosen path.[8]

Artifacts may also serve as tools for physically interaction with the environment. I shall call the motor skills this requires *interactive skills*. Interactive skills are exercised mostly through hand-held or manually operated tools. Merleau-Ponty's example of the typewriter is an example of an artifact that mediates interactive skills. The pressed key and the typebar activated by one's finger become an extension of one's finger through which it makes a mark on a sheet of paper. Similarly, when one uses a pen, a paintbrush, a vacuum cleaner, a razor, a hammer, a trumpet, a remote control, a knife, or a gun, one performs actions on the environment with a tool that is embodied within one's body schema.

Sometimes, an artifact that mediates motor activity is also customarily employed to mediate perception. Merleau-Ponty discusses the example of a blind man using a stick to navigate through the world as an example of both an acquired motor skill and an acquired perceptual skill: 'Learning to find one's way among things with a stick, which we gave a little earlier as an example of motor habit, is equally an example of perceptual habit.' (1962, p. 152). When learning to use the stick, the blind man acquires motor skills, as he learns to interact with objects in the environment using his stick and to navigate this stick successfully through this environment along with himself, but simultaneously also acquires perceptual skills, as he learns to perceive and locate elements in his environment through the stick. The dentist's probe is another example of an artifact that has both a perceptual and a motor function. In both examples, the *terminus* by which one physically engages the environment, that is, the lower end of the stick and the tip of the dentist's probe, is also the *terminus* where perception begins.

For many artifacts used in motor tasks, their perceptual function is, however, subordinate to their motor function, if it is there at all. A paint brush, for example, is not normally used as an instrument for perception, although it may, like the dentist's probe, be used to perceive the texture of a surface. When it is used in painting, the primary function of the paint brush is not that of a tactile instrument, although the paint brush gives perceptual feedback about the amount of pressure exerted on the canvas, that can be used to adjust one's motor acts. However, when using an airbrush, even this feedback is eliminated, as the contact with the canvas is no longer there. The airbrush is just like the feather on the woman's hat which also does not ordinarily give her perceptual feedback about her environment. Moreover, perceptual feedback does not always aid the execution of motor tasks. When navigating an automobile through a narrow opening, one may feel, through the car, that there are holes in the road, but these perceptions do not help one navigate through the opening more successfully.

Conversely, artifacts that are primarily used as perceptual instruments often, but not invariably mediate motor skills as well. Instruments for tactile perception such as probes are often also used to mediate interactive skills, as when the dentist uses the probe to remove some scale from one's teeth. A modification of navigational skills is required if a perceptual instrument significantly enlarges the bulk of one's body and one moves around while using it.[9]

4. Conclusion

To sum up, an embodied technology is a technology that is incorporated into one's body schema, which implies that it becomes part of one's bodily space (Merleau-Ponty's 'space of situation'). It then becomes an integral part of one's repertoire of motor or perceptual skills, and serves as a medium through which motor or perceptual functions, or both, are expressed. Perceptual functions that are mediated are either visual, aural or tactile functions. Motor functions that are mediated are either navigational functions or interactive functions (or both). As an artifact becomes incorporated into one's repertoire of skills, it often, though not invariably, enhances these skills. That is, it often extend the 'potentialities' of the body schema, and consequently what the body, as mediated by the artifact it incorporates, is able to affect or perceive in its environment. An exception is constituted by objects that merely serve to enlarge the bulk of the body, and complicate navigational tasks without enhancing one's potential, or even serve as a limitation.

When Ihde discusses embodiment relations, he discusses them in the context of an account of ways in which human beings experience technology. Given Ihde's interest in analyzing experiences of technology, it is to be expected that embodiment relations are construed, in his theory, in perceptual terms. Ihde's aim is to give an account of recurrent patterns of experience that embodied artifacts bring with them, whereas Merleau-Ponty is more interested in showing how embodiment relations are constituted. In this sense, the two theories are complementary.

However, when Ihde characterizes the patterns of experience that are correlated with embodiment relations, he only recognizes one pattern of experience, that only holds for artifacts that mediate perception: the experience of one's environment through an artifact. Artifacts that mediate motor tasks were argued to also display a distinct pattern of experience. This is the direct experience of the location of the artifact, relative to objects and places in the environment. Thus, the woman wearing the feathered hat 'feels' where her feather is, just like she 'feels' where her hand is.

In conclusion, my study of Merleau-Ponty's theory of embodiment relations serves to extend Ihde's theory of embodiment relations in two ways. First, it supplements his theory with an account of how embodiment relations are *constituted*. Embodiment relations were shown to be constituted by the incorporation of artifacts into the body schema. Second, it extends Ihde's account of the experience of embodiment relations by distinguishing, next to experiences of one's world through an artifact, direct experiences of the location of an artifact relative to an environment. These are distinct experiences, the first found in perceptually embodied artifacts, the second mainly in motor embodiment.

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NOTES

[1] See Bermúdez et al. (1995) for an excellent anthology of work on bodily awareness and self-consciousness.
[2] Although Merleau-Ponty was arguably the first philosopher to present a theoretical account of embodiment relations, the first observation of the existence of embodiment relations may be found in Heidegger (1962/1927). Heidegger called objects that are only recognized as mere objects present-at-hand (*vorhanden*). Objects that are understood as means to one's ends, he called ready-to-hand (*zuhanden*). In one passage in *Being and Time*, Heidegger appears to distinguish between objects that are merely ready-to-hand, and objects that are ready-to-hand in a special way, which he called 'proximally ready-to-hand' (*zunächst zuhanden*): 'The peculiarity of what is proximally ready-to-hand is that, in its readiness-to-hand, it must, as it were, withdraw [zurückzuziehen] in order to be ready-to-hand quite authentically. That with which our everyday dealings proximally dwell is not the tools themselves [die Werkzeuge selbst]. On the contrary, that with which we concern ourselves primarily is the work - that which is to be produced at the time; and this is accordingly ready-to-hand too. The work bears with it that referential totality within which the equipment is encountered' (1962, p. 99). Artifacts that are proximally ready-to-hand may now be identified as embodied artifacts.
[3] The most relevant passages in *Phenomenology of Perception* are pages 142-147 on motor habits and pages 151-153 on perceptual habits.
[4] Merleau-Ponty, 1962, p. 98ff. Merleau-Ponty's *schéma corporel* is translated as 'body image' in the English translation of *Phenomenology of Perception*, but I, like Tiemersma (1989) prefer the more literal translation 'body schema.' This term is also to be preferred because the body schema is, as Merleau-Pony makes clear, not an image, but a nonrepresentational structure. Moreover, the term 'body image' is nowadays often used in psychology in a different sense, to refer to perceptions of one's own body along social and aesthetic dimensions. Tiemersma (1989) presents a review of the philosophical, psychological, and neuroscientific literature on the notions of body schema and body image.
[5] The experienced world is hence subjective, because its features are conditioned by the body schema. However, it is not a mere projection of the body schema. One may instead say that an 'objective' world (Kant's *noumena*) and the body schema jointly produce an experienced world, which is therefore not a pure construction of the subject. Because there are invariants in the body schema that all human being share,

there are moreover features in the world that are recognized by every human being, and that are therefore 'objective' in the sense of being independent from any one person's subjective experience. Note, moreover, that, according to Merleau-Ponty, Euclidean space is an abstraction of the oriented 'space of position' of the experienced external world (Euclidean space abstracts from 'subjective' orientational features of space such as 'behind', 'near' and 'above'), which is in turn based on the 'space of situation' of the body.

[6] Merleau-Ponty's 'habitude' is often translated as 'habit', but I agree with Dreyfus (1996) that 'skill' is a more accurate translation.

[7] Merleau-Ponty held that every motor skill has a perceptual aspect, and every perceptual skill has a motor aspect. Nevertheless, he makes a clear distinction between perceptual and motor skills.

[8] When considering examples of embodied artifacts that require modifications of ordinary navigational skills, the question is raised how malleable the body schema is, and just how far and how easily it can be extended. A person riding a bike or pulling a cart has to extend his body space to include the bike or cart. Similarly, a person flying a radio controlled airplane expresses navigational skills through the airplane. But here, it seems, there is a separation between one's own body and the artifact. The airplane becomes a second reference point, next to one's own body, relative to which objects in the environment are encountered. Similar separations occur when playing video games, or when using virtual reality technology.

[9] It may be thought that because embodied artifacts mediate and extend motor and perceptual skills, the primary purpose of embodied artifacts is to enhance skilled action or skilled perception. However, not all embodied artifacts serve to extend action or perception. *Cognitive artifacts* (Norman, 1993) are artifacts that are able to represent, store, retrieve and manipulate information. They include items like computers, calculators, abacuses, as well as pencil and paper, and books. Cognitive artifacts extend cognitive abilities, such as abstract thought, memory, problem solving, and language use. Merleau-Ponty believed cognitive abilities, or skills, to be grounded in, but not directly reducible to, sensory-motor skills. When a cognitive artifact, such as a calculator, engages in an embodiment relation with someone, it becomes a medium through which representations (usually in the form of symbols) are perceived and manipulated. In this way, a cognitive task is transformed into a perceptual and motor task.

REFERENCES

Bermúdez, J., Marcel, A. and Eilan, N. (Eds.) (1995). *The Body and the Self*. Cambridge, MA and London: MIT Press.

Brown, H. (1990). Perspective Realism. *Studies in the History and Philosophy of Science* 21: 211-242.

Dreyfus, H. (forthcoming). The Current Relevance of Merleau-Ponty's Phenomenology of Embodiment. In G. Weiss & H. Haber (Eds.), *Perspectives on Embodiment: The Intersections of Nature and Culture*. New York and London: Routledge.

Hacking, I. (1983). *Representing and Intervening*. Cambridge: Cambridge University Press.

Heidegger, M. (1962/1927). *Being and Time*. J. Macquarrie & E. Robinson (trans.). New York: Harper and Row. Originally published in German as *Sein und Zeit*.

Ihde, D. (1979). *Technics and Praxis: A Philosophy of Technology*. Boston: D. Reidel.

Ihde, D. (1990). *Technology and the Lifeworld: From Garden to Earth*. Bloomington: Indiana University Press.

Ihde, D. (1991). *Instrumental Realism. The Interface between Philosophy of Science and Philosophy of Technology*. Bloomington: Indiana University Press.

Ihde, D. (1993). *Philosophy of Technology: An Introduction*. New York: Paragon Press.

Merleau-Ponty, M. (1962/1945). *Phenomenology of Perception*. C. Smith (trans.). New York and London: Routledge. Originally published in French as *Phénoménologie de la Perception*.

Norman, D. (1993). *Things that Make us Smart: Defending Human Attributes in the Age of the Machine*. Reading, MA: Addison-Wesley.

Tiemersma, D. (1989). *Body Schema and Body Image. An Interdisciplinary and Philosophical Study*. Amsterdam/Lisse: Swets & Zeitlinger.