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# A Socio-Material Ecology of the Distributed Self

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When distributed to different artefacts, the self appears in a multitude of shapes, characterized not only by its materiality but also by the necessity to preserve at least an illusion of a core self. The experience of a continuous evolution of these overlapping “selves”, many of which are materialized together with others’ overlapping selves, cannot be captured by traditional design approaches, nor can ethical aspects and conflicts of the right to express yourself through artefacts. This article, with its empirical basis in an interdisciplinary EU funded project, PalCom, is an attempt to test both *ecological* concepts and relationships and *sociological* (actants, actor-network-theory) ones. No meaningful separations are observed between the human ecology and sociology and the artefactual ones. Instead, it is the whole system of people, practices, values, and technologies in a particular situatedness that is meaningful to pinpoint and elaborate.

In this text, the notion of the distributed self will be discussed. By this I mean the way artefacts are included in the study of an individual. There are many things to be considered when thinking of the socio-materiality of

this distributed self. Here, two different approaches are tested, separately and intertwined: a sociological and an ecological.

The actor-network-theory (ANT) approach as implemented below rejects the simple notion of the self as being a biologically defined entity. It is a non-linear and non-centralized view, assessing parallel and distributed processes where the individual is in constant negotiation and continuous dialogue with other people, as well as artefacts. Bateson talks about 'the pattern that connects' and suggests a similar holistic approach to knowledge and meaningful relations.<sup>1</sup> The distributed self is considered a snapshot of the relations between the actants (species) in the network (ecology).

Both the sociological and the ecological approach challenge simple design principles that create systems that are isolated, static, and final. People are in continuous dialogue with each other, as well as with the distributed physical artefacts in interactions that trigger and guide our actions in the world.

As technology and media become more intertwined with our perceptions of the self and the very conditions of life, an alternative approach could be necessary: changing from seeing humans as parts of ecosystems, to viewing the individual together with meaningful artefacts as an ecosystem in itself.

Examples from a case study<sup>2</sup> are provided to highlight issues which are visible when using the ecological/sociological approach.

## Metaphors of Technology

"Technologies matter anthropologically, among other reasons, insofar as they compromise what Haraway names materialized figurations (1997:11); that is, arrangements of material and discursive practice brought into more and less coherent relations, which in turn shape human experience."<sup>3</sup>

Metaphors are used extensively within design research and design practice. They are frequently used to either describe concepts, or as a creative tool in the design process. A metaphor (from the Greek *metaphora* – transfer) is '... a set of linguistic processes whereby aspects of one object are 'carried over' or transferred to another object so that the second object is spoken of as if it were the first'.<sup>4</sup> Metaphors as linguistic tools certainly influence the way we think and act.

In design theory, metaphors have been used to describe the activity of design itself, ranging from Herbert Simon's design as problem-solving<sup>5</sup>, Rittel and Webber's dilemma approach<sup>6</sup>, to Schön's reflective practice.<sup>7</sup> There are also several metaphors used when talking about technological artefacts, for example technology as a tool, text, or system.

Metaphors are powerful for different purposes in different contexts, but they can also be deceptive if used carelessly. This calls for caution and deliberation when choosing one. Using common features of ecosystems, the perception and construction of the distributed self will be described as an ecology made up by the relationships between an individual's body, personal artefacts, and the environment.

### **Tool Metaphor**

The tool metaphor is probably the the most widespread one in design and engineering. When using this metaphor in design, the primary focus is on functionality (e.g. efficiency and effectiveness) and usability (as in ergonomics). Norman, who writes extensively on design issues, introduced the term *perceived affordance*, which deals with the tool aspects of designed artefacts. The term 'affordance' (as a noun) was invented by J.J. Gibson, and originated in his study of (mainly visual) perception and control of action. It denotes the functional value of things and organisms in the environment:

"The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment ..."<sup>8</sup>

The term has been adopted and redefined by Norman and others within the design community in the context of usability. Norman stresses that the word 'affordance' has been misused in so many ways, for example as something which can be designed into an artefact.<sup>9,10</sup> Norman explicitly separates real from perceived affordance in an attempt to clarify the difference between the Gibsonian physical affordances and the perceived functions of designed artefacts in use.<sup>11</sup> The affordance of an artefact is different for different people and situations, as people tend to act in ways that make things and situations meaningful to them based on personal experiences, knowledge and expectations. The affordances that govern the possible interactions within the system are not inherent or static but depend on the functional relationship between an individual or group and the environment. People are in a way defined in their (meaningful) relations to artefacts as well as other people.

It is apparent that the tool metaphor is limited when it comes to encapsulating meaning outside the pure user context. Another metaphor of technology more apt for the description of meaning is the text metaphor.

## Text Metaphor

The text metaphor of technology is (tautologically?) a linguistic/semiotic one. Critical Theory and a number of postmodern theories propose the ‘reading’ of phenomena in the world as texts. In his widely cited essay *Technology is society made durable*, Latour describes how artefacts can carry messages and how they interact in a web of (human and non-human) actors to complete a *program*, for example returning a hotel key.<sup>12</sup>

In design, there are lively discussions on matters such as the usability, ergonomics, and aesthetics of artefacts, but the link between the self and artefacts in the world is also semiotic – a matter of how people ascribe meaning to everyday things and events as well as strategies for how to act accordingly. Dourish describes this embodied interaction as ‘the creation, manipulation, and sharing of meaning through engaged interaction with artefacts.’<sup>13</sup>

The text metaphor complements the tool metaphor since it acknowledges individual interpretation and sense-making in relation to technology. Since this creation of ‘meaning’ depends on a vast number of factors, this metaphor has its main merits for example when explaining why something is meaningful rather than used as an aid for the design of artefacts.

## System Metaphor

The system metaphor is a wide concept and includes many different writers and approaches (Nardi and O’Day refer to Ellul, Winner and Postman). There is a common ground in their scepticism towards technology, but where Ellul seems downright pessimistic, Nardi and O’Day find grounds for action and initiative. The system metaphor often takes a bird’s-eye perspective on technology. One thing that Nardi and O’Day consider is lacking in this metaphor is *locality*. Another word for this could be *situatedness*, as Suchman speaks of<sup>14</sup> In a design process, it is necessary to be ‘where the action is’ in order to capture the specifics of a situation.<sup>15</sup>

## Ecological Metaphor

Ecology (‘oekologie’) as a term was coined by Ernst Haeckel in 1866 as being the “science of the relations between the organism and the environmental outer world.”<sup>16</sup> In biological terms, ecology is the study of the interaction between different species within an environment. Traditionally, ecology is concerned only with living organisms such as animals and plants, and their metabolic processing of organic and non-organic matter in their natural habitat. There are common key features of any ecosystem, e.g.:

- Ecosystems are local, evolving, and self-generative entities.
- Different species in the system occupy separate niches, each with specialized functions within the environment. Keystone species are those that are vital for the existence of an ecosystem.

- Species within this environment are dependent upon each other and exhibit co-evolution through coordination and competition.
- Ecosystems have some kind of metabolism – a cycling of resources.

Human-made environments can also be considered to be ecosystems, such as a city, an office or a home. Many fields of research and practice, such as philosophy, anthropology, natural philosophy, literature, history, sociology, and aesthetics, have adopted the ecological concept.<sup>17</sup> As a term, ‘ecology’ has been used by some interdisciplinary scientific genres such as *Engineering Ecology*. Metaphorically it has been used to describe complex environments not relating to biology as such, like *Media Ecology*.

Nardi and O’Day argue that the common metaphors of technology – tool, text, and system – do not quite cover the practice they have encountered ‘in the wild’.<sup>18</sup> They introduce the term *information ecology* as an alternative to the above metaphors of technology. An information ecology is a system of people, practices, values, and technologies in a particular local environment. In information ecologies, the spotlight is not on technology, but on human activities that are served by technology. One common feature of such ecosystems is that the creation of meaningful relations within an ecosystem is the result of an ongoing and dynamic interaction between people, artefacts, and the environment. This has many similarities to actor-network-theory and its view on actants.

Similarly, Krippendorff uses the term “ecology of artefacts” as a description of how artefacts are related to each other. He claims that in an ecology of artefacts, the meaning of an artefact actually consists of its possible interactions with other artefacts rather than its specific usability.<sup>19</sup> The word ‘ecology’ is used in a conceptual and metaphorical way, and not in its original biological sense. One parallel could be the common metaphor used in computer interfaces, the desktop metaphor (files, folders, trash bin etc).

## **ANT – A Sociology of Associations**

Follow the actors themselves, is the slogan of our sociology; indeed, but it is not said how to follow them.<sup>20</sup>

Another, complementary approach to the materiality of relationships is the sociological actor-network-theory (ANT). In his book *Reassembling the Social*, Bruno Latour makes a distinction between what he calls ‘the sociology of sociology’ and his proposition of a ‘sociology of associations’. The former assumes the particularities of what is called social, and attributes it with abilities to describe the world in ways dissimilar from other disciplines, such as biology. The analogue situation in sociology would be to assume a special social ‘matter’ which could form the units of analysis. This is

another reason for Latour's division and is based on his aversion to the widespread use of the term 'social' as a property in itself; that there is a special matter of which the social is made up. Rather, Latour proposes another interpretation of the word *social* to signify *creating connections*, and wants to investigate what these connections make up, what he calls *assemblages*. This 'sociology of associations' is described by examining five uncertainties of what the world is made up of<sup>21</sup>:

- *the nature of groups: there exist many contradictory ways for actors to be given an identity;*
- *the nature of actions: in each course of action a great variety of agents seem to barge in and displace the original goals;*
- *the nature of objects: the type of agencies participating in interaction seems to remain wide open;*
- *the nature of facts: the links of natural sciences with the rest of society seems to be the source of continuous disputes;*
- *and, finally, about the type of studies done under the label of a science of the social as it is never clear in which precise sense social sciences can be said to be empirical.*

By doing this, the need of a 'social glue' that holds the social context together vanishes. The social is no longer a 'thing' but connections between (non-social) phenomena and things. The social is hence no longer an *a priori*, but something the participants make up when dealing with controversies. The sociology of associations is the study of these in-betweens.

According to the original form of ANT, an object is 'an effect of an array of relations, the effect, in short, of a network. ... An object is an object so long as everything stays in place. So long as the relations between it and its neighbouring entities hold steady'.<sup>22</sup> This is what Latour calls an 'immutable mobile'.<sup>23</sup> In some respect, there is no difference between human and non-human actors in ANT. Naturally, there are differences, but the overall aim is to re-evaluate the importance of including artefacts in the equation.

The point in the end is not to assign agency either to persons or to things, but to identify the materialization of subjects, objects and the relations between them as an effect, more or less durable and contestable, of ongoing socio-material practices.<sup>24</sup>

An actor in ANT is not what performs an action, but rather 'the moving target of a vast array of entities swarming toward it'.<sup>25</sup> In other words, it is never really clear who acts, nor can the actions of an individual actor be isolated from the actions of others. The actor is defined by its relations to the countless actions of others. This system of mutual dependency has many similarities to the ecological view.

## The Pregnancy Case

To provide concrete examples of the application of the theoretical approach proposed here, a case study from the PalCom project will be used. PalCom was a European IST (Information Society Technology) project that ran between January 2004 and December 2007. Palpable computing envisions ubiquitous technologies designed to support people in making their actual and potential activities and affordances clearly available to their senses. The research approach was grounded in the participative design tradition, and involved both development of technological systems and use cases.<sup>26</sup>

The case study to be discussed dealt with health care services supporting women during pregnancy.<sup>27</sup> The study was performed in Denmark and involved ten pregnant women (in two separate sets)<sup>28</sup> four fathers-to-be (participating second-hand) and a dozen health care providers. Input was collected through eight workshops, an ethnographic survey, and development of a series of prototypes. The health care personnel and pregnant women participated actively in the study, providing feedback on the prototype development, use situations, and data evaluation.

## Background

Currently in Denmark, a pregnant woman is in contact with several different health care professionals in different locations over an extended period of time. This includes midwives, general practitioners, and in some cases various specialists. Since the clinical information is presently distributed among many parties, it was difficult for the pregnant woman to assess her situation. One task was thus to support her handling and collection of data. Another concern was the type of information exchanged. From a clinical perspective the focus was on health related topics, such as diet, exercise, medication, drinking and smoking habits. It was shown in the study that personal and clinical information were considered equally important by the pregnant women.

## The Memory Stone

In current work practices, information about the status of the foetus and the pregnant woman is stored in a number of different places, not only on various media, but also in different geographical locations. This scattering of information is partly due to the origin of the data (i.e. information recorded by a midwife is stored on the local computer or paper file). There is, however, no single place where all information is collected. The closest one can get is the personal pregnancy journal (“vandrejournal”), a paper folder kept by the pregnant woman herself. This increasingly thicker folder is brought to each consultation and updated by the midwife or general practitioner. It thus has a dual function: the main collection of health data and the main means of communication between groups of health care professionals.





**Figure 1**

The Memory Stone. Concept prototype (left) and functional prototype (right).

One part of the design solution was to provide each woman with a digital artefact, called *The Memory Stone*, intended as a technological support for storing, recalling, and communicating things of interest, both clinical and personal. This assistive device was to be used both during consultations, and at home or in other private settings. Its physical design was originally intended to mimic a stone in order to give associations of permanence and durability. It had an internal flash memory to hold the data, a Bluetooth radio for wireless communication, and a button for user interaction. Being a part of the larger PalCom technological architecture, it could be integrated with other devices such as a PC or a mobile phone. This extended the simple digital storage functionality of the device to being included in the technological infrastructure of the midwife or physician as well as the home.

### **Combining Ecology and Sociology**

In this section, a series of examples from the case study will be presented in order to exemplify and integrate some aspects of the socio-material and ecological approach proposed.

### **Artefacts of the Self**

Instead of conceiving the relation between person and environment in terms of moving coded information across a boundary, let us look for processes of entrainment, coordination, and resonance among elements of a system that includes a person and the person's surroundings. When we speak of the individual now, we are explicitly drawing the inside/ outside boundary back into a picture where it need not be prominent. These boundaries can always be drawn in later, but they should not be the most important thing.<sup>29</sup>

To draw the perimeter of the self, one has to have an apprehension of what is on the inside and what is on the outside. Also, agreeing on the fact that people interact, this boundary has to be permeable in the sense that there can be exchange over this border.

One way of drawing this boundary is to see what a group of people have in common. The term *community of practice* (CoP) was introduced by Lave and Wenger to describe groups of people sharing knowledge and practices.<sup>30,31</sup>

An artefact that bridges the gulf between different CoPs functions as a 'boundary object', a term first described by Star.<sup>32</sup>

(Boundary objects) ... are those objects that both inhabit several communities of practice and satisfy the informational requirements of each of them. ... Such objects have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting communities.<sup>33</sup>

The different CoPs can organize their interconnections around an artefact, a boundary object, that should be robust enough to transport information between these communities, but at the same time allow for local interpretation. The knowledge embedded in the boundary object cannot be extracted or interpreted locally without prior knowledge within the receiving community.

A boundary object is hence a means for the production of meaning. In Latour's terminology, such an artefact (actor) can be either a mediator or an intermediary.<sup>34</sup> In his vocabulary, an intermediary is 'what transports meaning or force without transformation.' The effects of intermediaries are trivial and predictable. Mediators, on the other hand 'transform, translate, distort, and modify the meaning or the elements they are supposed to carry.' Dealing with mediators, it is not possible to foresee the outcome by studying what is given beforehand. In the distinction between a 'sociology of associations' and what Latour calls a 'sociology of sociology', he states that the latter uses one type of social aggregate, few mediators, and many intermediaries, whereas the former does not have any social aggregate and an infinite number of mediators.

### **Example: Information vs. Meaning**

The pregnancy journal is a boundary object between different communities of practice within healthcare. Since the clinical information is intended for other practitioners, the content and form of the journal are not supposed to (should not) be transformed during transport. Wenger calls this a 'reificative connection'.<sup>35</sup>

In Latour's terminology, the pregnancy journal can be seen as an intermediary in the network.

The pregnancy journal is not intended for the pregnant women. They don't understand the language used in the pregnancy journal (Latin and Greek words, sloppy handwriting, unexplained abbreviations, etc). Thus they are excluded from this exchange. The pregnant woman has the *information*, but since she cannot interpret it, it has no *meaning* to her.

*The Memory Stone*, on the other hand, is a boundary object between the pregnant woman and the healthcare professionals. Whereas the healthcare professionals asked what the *Memory Stone* is useful for, the pregnant women described what it meant to them. For the pregnant women, the *Memory Stone* was more than a trivial storage device, as in the tool metaphor, and became a part of their identity. It had connotative and semantic meanings due to its shape and material, and there was a sort of attachment between the women and her *Memory Stone*. Many of the pregnant women reported that they liked to carry the device with them, which is unlikely with the traditional paper-based pregnancy journal.

Since the information stored on the device is (partly) personal, and thus has little or no meaning for the healthcare professionals, it is another form of boundary object, something Latour would call a *mediator*. The meaning of the information stored on the *Memory*

**Figure 2**  
Handling Information.



*Stone* is created through the woman's interpretation in a specific situation.

### **Niches and Species**

The environment in the case study included computers, paper journal, telephones, faxes, e-mail, and other media, as well as a wide range of different people and locations. Most of the health care personnel used clinical or technological tools to carry out their tasks, such as blood and urine tests, computers, faxes, ultrasound scanners, and others. These were used for gathering clinical data as well as communicating information. The pregnant woman, on the other hand, could not rely on any technological aid in these situations apart from occasional personal devices such as personal digital assistants and mobile phones. These devices were not suitable or adapted for these kinds of tasks and hence were not commonly used. Thus, there was an apparent imbalance of technological support which could be alleviated by introducing the *Memory Stone*.

Ecologically, the professionals and the pregnant woman (and her spouse, friends, and family) could be said to occupy different niches within this system, having special capabilities and drawing on different resources. The relations between these 'species' could be predatory, competitive, or cooperative. In the predatory sense, it is not necessarily a question of negative conflicts. Rather, a predator species is related to its prey in a feedback loop, thus limiting and negotiating with each other. One example of a competitive relation from the pregnancy case was when different professionals had similar functions within the system. The differences between these categories of species could be a matter of territory, status, or professional focus, and led to confusing and counterproductive situations, according to the participants.

### **Example: Cooperation**

In the pregnancy case, there were many different categories of professionals: midwives, general practitioners, specialists, nurses, nutritionists etc. Normally, these healthcare professionals had little or no direct contact with one another, mostly forwarding information via the paper pregnancy journal carried around by the pregnant woman herself, or through an internal database system. Despite this indirect mode of communication they managed to work towards a common goal, i.e. the well being of the foetus and pregnant woman. Hutchins talks about the interplay between these actors as a form of distributed cognition. He describes this phenomenon of collective (cognitive) skills where individual members have limited resources and capabilities, but when combined they function as a unit (like the crew on a ship, as in his example). The distributed collaboration of the professionals in this case can be viewed as an example of a cooperative and symbiotic

relation within an ecology where different species are sharing and generating mutually beneficial resources.

The introduction of new species in an ecosystem could also have drastic implications. In the pregnancy case, one of the keystone species when it comes to communicating data was the paper journal carried around by the pregnant woman. This was the only single place where information from all health care professionals was collected. The introduction of the digital assistive device not only could oust the paper journal, it would expand this specific niche and compete with other species such as mobile phones and notebooks.

### **Example: Competition**

An example of the impact of materiality of information in a relation was the introduction of the digital device to the male spouses. There was a noticeable increase in their interest and participation when the digital artefact was introduced into their lives as expectant fathers. This artefact in some cases proved to be more effective for communicating information than the existing human-to-human relations.

One possible explanation could be that their interests in technology made them more receptive to the content, using the device as a mediator. Another explanation was the transformation of the information from the traditional paper-based written form into a high-tech interactive form where additional types of information can be stored and shared (images, sound clips, video).

### **Locality**

Ecosystems are local to a specific environment. If the perspective changes for example to include a larger area or a different set of species, the ecosystem turns into a different one. Similarly, the use of the health care devices and services in the pregnancy case was dependent on the specific location, the people engaged, and the devices used. For example, the *Memory Stone* was primarily used as a digital memory at the midwife's office, but while lying in the woman's pocket its tactile and semantic properties were the most appreciated (still related to memory, but rather as associations than data). Several of the participating women noted that the device reminded them of an egg, and that this made them think of it as a representation of the foetus. This symbolic association was not only based on the physical design, but also on the meaning of the information stored in it.

### **Example**

The role of the pregnant woman also changed when moving from one place to another. From being (relatively) less informed than the midwife at her office, the pregnant woman became an expert when explaining things for her spouse at home. Ecologically, she turned

from being a dependent species to becoming a keystone species. The circumstances and environment influenced the meaning and function of the different species (artefacts and people) of the ecosystem.

### Multiple Selves

It is crucial to avoid seeing the self as something *a priori* in the socio-material approach taken here. Latour, like Goffman, suggests that there are many different possibilities of groupings that are simultaneous and equal. Depending on the context of a study, the notion of a ‘self’ of any given individual could be seen as a snapshot of all possible selves. This is commonly spoken of as roles; a person has many roles, depending on the context, age, and other factors.<sup>36</sup> One can be a parent, son, and brother at the same time, but one behaves and is defined differently depending on which role is in focus in a given situation. This multitude of identities is one part of the concept of the distributed self, and is a product of time, place, and all the interrelated artefacts in that situation.

### Example

The women in the case study had several roles or identities during the research project: pregnant women (as individuals, and as representatives of the group ‘pregnant women’); wives; daughters; research informants; professional workers etc. The pregnancy was also considered by the women as a time of preparing themselves for their new roles as parents and involved a period of change, concerning both their ego identities (the self) and their social identities.<sup>37</sup>

### Change and Co-Evolution

According to Eriksson, the formation of identity follows certain steps throughout the course of a person’s life. One’s self is considered to be dynamic over time, constantly subject to negotiations, exchange



**Figure 3**  
At a consultation and at home.

and flux. Although changing, the self (normally) exhibits a great resilience and seems to be biologically, psychologically, socially and cognitively more or less consistent and coherent over time. One way of expressing this is that past experiences are incorporated into the present self – growth carries history, like the circles in a tree or the spirals of a shell. This homeostasis of the self is a functional balance of personal history over time and has similarities with the evolutionary processes of an ecosystem as a whole, and as such it is a form of epigenesis – a form of becoming or evolution.

Most of the pregnant women in the case study had higher education and professional positions that demanded considerable responsibility. All but one of the participating women in the study were pregnant for the first time, and had little or no prior direct experience of a pregnancy. Due to this situation, they found themselves being to some degree ignorant and powerless, which was even more evident for the spouses who to a lesser degree participated during the consultations.

### **Example: Co-Evolution**

The progressive learning of these first-timers influenced the focus and depth of the information provided by the professional staff. The collection and arrangement of clinical and personal information changed gradually over time, adding to the accumulated knowledge of the individual women. There seemed to be a co-evolution between the pregnant woman and the *Memory Stone*. In that sense, it became an integral part of the re-formation of the self.

From an ecological perspective the participatory development of technology as well as the interaction between researchers, participants, and artefacts can be viewed as a process of co-evolution within the project itself. The close co-operation and interdependency provided instant feedback and regenerative responses, which is one fundamental feature of an ecosystem.

### **Metabolism**

From the ecological perspective, the handling of the *Memory Stone* device and the data was a form of metabolism in the pregnancy case. The process of storing, retrieving, discarding, and updating information meant cycling of resources. Data were passed from one species to another, each processing and altering it according to his or her specific needs.

### **Example**

An unexpected effect of changing the materiality of the pregnancy journal was the need of taking care of it. It demanded attention and physical handling in other ways than the paper journal (charging batteries, transmitting data to and from computers etc). There was a transformation of the interaction itself – instead of handling information they were interacting with a digital artefact. So, caring

for the *Memory Stone* became a parallel to (but not a substitute for) caring for the foetus.

### Coda

The socio-material approach taken in this text calls for a discussion of what it means to be an individual. By extending the role of artefacts, from being tools to become integral parts of the individual, the aim is to investigate implications for design (research) into the domain of personal expression and meaningful relations. As a parallel to McLuhan's slogan of media as an extension of man, artefacts could be regarded as extensions of the self, or using the terminology of Bolter and Grusin, a hypermediated self.<sup>38</sup>

By putting our physical bodies inside our extended nervous systems, by means of electric media, we set up a dynamic by which all previous technologies that are mere extensions of hands and feet and bodily heat-controls – all such extensions of our bodies, including cities – will be translated into information systems.<sup>39</sup>

Haraway stresses the general and extensive co-dependency between humans and technology; there exists no opposition between them since they are inescapably intertwined. She writes: "Late twentieth-century machines have made thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines."<sup>40</sup> Subjectivity and identity must take into account the bodily as well as the technified exterior, as Haraway's companion species, the cyborg, exemplifies.

Technological tools and other artefacts carry social meaning. Social understanding, values, and practices become integral aspects of the tool itself. Most of us probably don't think of a telephone as a machine; instead, we think of it as a way of communicating.<sup>41</sup>

The distinction between the inner self and the outer, between the body and artefacts in the environment is blurred. In some sense, some artefacts could be considered part of an individual, not only as a matter of 'appropriation' where tools are used to fulfil some instrumental purpose, but of symbolic, meaningful incorporation. Goffman describes this symbolic interaction from a dramaturgical perspective taking into account both the roles of the individual and the props and stage.<sup>42</sup>

So where does the self end and the artificial world begin? Are artefacts simply tools or representations or do they have a more profound impact on the perception of self and phenomenologically



how we are in the world? When talking about the self as being distributed onto artefacts in the environment, one can argue that the term 'individual' loses its meaning of an indivisible subject and no longer signifies a person but something else. The self is in other words simultaneously embodied (biologically) and embedded (in artefacts).

The boundary of the self is permeable depending on the perspective taken. In this text, the individual is no longer indivisible and isolated from its environment. Instead, the unit of analysis is the system of more or less stable relations between artefacts and people, in this case a single person. What is to be considered a 'self' is thus not bounded by the biological body. As Stelarc puts it, "The skin no longer signifies closure."<sup>43</sup>

### Notes

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