

**HOW SOCIAL IS THE SOCIAL?
RETHINKING THE NATURE OF ARTIFACTS IN COGNITIVE SCIENCE**

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Introduction

At its core cognitive science has two main positions: the first is held by those who believe that the mind is primarily individual, thought is an internal physical process, and essentially private (see for example, Churchland & Churchland, 1998); the second position is maintained by those who argue that the mind and thought are essentially social (see for example Bakhurst, 1995; Cole, 1996). This basic dualism is translated and extended into a series of logics of exclusion—be it the mind/body problem, the individual/collective problem or the nature/society problem—which have, for a long time, haunted philosophers and cognitive scientists alike.

There is no easy solution for these problems, and it is not my intention to provide grandiose schemata. In this paper I will explore ways which allow for the re-positioning of the elements—and categories of elements—that are involved in cognitive processes. Hence, throughout this paper I will argue the following: Cognition is not primarily an internal process, but one that is socially shared. The social, however, is constituted by more than people. It is constituted by ‘hybrid’ networks, or sets of relationships created among people through the use of artifacts. Without these artifacts, the relationships could not be established/maintained and hence cognition would not function the way it does.

I believe there is, nowadays, a need to re-conceptualize the nature of our relation to artifacts and its impact on cognition. This need arises from the increasing number of intersections between the domain of the technological and everyday life. As more and more of our lives are spent on computer networks, the interweaving of artifacts and humans will become inevitable, and the shifts in the nature of their interaction will also be ineluctable. It is therefore necessary to re-think the character of the social in its relation to cognition.

In order to sustain such an argument I will draw upon three different *schools of thought* that, although not formally connected, in my view complement and develop one another in interesting and fruitful ways. In Section One I will discuss Vygotsky’s sociocultural theory, with a particular emphasis on the notion of mediation through artifacts. In Section Two I will explain Marshall McLuhan’s view of artifacts as extensions of Man. Section Three, is dedicated to providing an analysis of Actor-Network Theory (ANT), in which humans and non-humans are each considered to be actors, their agency depending on their relationships. The fourth and final section is dedicated to the study of the implications and possible further developments of this line of thought. Here I will try to highlight the parallels between the developments in the role of artifacts, from mediators between the individuals and society (Vygotsky), to extensions of the private onto the social (McLuhan) and finally, to actors in their own right (ANT), and the nature of cognition.

In other words what I am arguing here is that as our theorizing regarding the nature and role of artifacts changes so does the way in which we conceive the nature of cognition. The two tables below exemplify these parallel evolutions:

| | Vygotsky | McLuhan | Actor-Network Theory |
|------------------|-----------------|----------------|-----------------------------|
| Artifacts | Mediators | Extensions | Actors |

Table 1: The nature and role of artifacts

| | Vygotsky | McLuhan | Actor-Network Theory |
|----------------|--|--|-----------------------------|
| Thought | Social → private (individual development) | Private → social (historical development) | Relational |

Table 2: The character of cognition

*Section One – Vygotsky's sociocultural psychology:
Artifacts as mediators; Thought is social and then internalized*

Lev Semyonovich Vygotsky was a Russian psychologist who applied Marxist social theory to developmental psychology. His approach to cognitive development is sociocultural, that is, it works on the assumption that “action is mediated and cannot be separated from the milieu in which it is carried out” (Wertsch, 1991, p. 18). In a nutshell Vygotsky's theory consists of the interaction between four main notions: higher mental processes, mediation, psychological tools and internalization. In brief one could say these four notions interact in the following way: *Higher mental processes* are what distinguishes man from other animals. They are what allows man to distance him/herself from the world and act instrumentally upon it. Because they are socially meaningful processes—thus external to the individual—higher mental functions are *always mediated*. This mediation is done by what has been called *psychological tools*, or cognitive technologies or cultural tools. When the individual masters the higher mental processes they are then *internalized* and, in a sense, the social becomes available as a private tool. The process of internalization is not neutral: not only does the individual transform that which is internalized; but his/her own nature is also changed in this process (Vygotsky, 1983, p. 90; quoted in Kozulin, 1990, p. 115).

Vygotsky advocated that to understand what is unique in human behavior one has to take into consideration, (a) the “historical character of human behavior and learning” (Kozulin, 1990, p. 81). That is, individuals use not only physical experience, but also historical and cultural experience to make sense of the world. And (b) “the social nature of human experience” (Ibid, p. 81), i.e., individual experiences are only a part of the pool of experiences that are available. Hence, from a sociocultural perspective, what is unique about humans is the fact that their need and ability to mediate their actions through

cultural means that are transmitted from generation to generation (Cole & Wertsch, n.d.; for more on culture see Geertz, 1973, pp. 44-50).

It is not enough to say that human beings mediate their actions through the use of artifacts. It is necessary to qualify those actions, and in order to do that, Vygotsky describes two types of mental processes, lower and higher. The lower mental functions are genetically inherited, and allow only for a direct, instinctive and impulsive response to the environment. Higher mental functions, on the other hand, allow for instrumental action upon the world. Higher mental processes (or functions) are “by definition, culturally mediated; they involve not a 'direct' action on the world, but an indirect action, one that takes a bit of material matter used previously and incorporates it as an aspect of action (Cole & Wertsch, n.d).

Vygotsky argued higher mental processes are not merely an extension of lower mental processes, rather, they are “a function of socially meaningful activity” (Kozulin, 1990, p. 113). That is, higher mental functions “necessarily appear initially in an external form because they are social processes” (Wertsch, 1985, p. 62) in which the child engages. What a child learns will, thus, depend upon the higher mental processes that are available in his/her given cultural environment.

As stated above, besides their social character, “[h]uman higher mental functions ... are [always] *functions of mediated activity*” (Kozulin, 1990, p. 112). That is, these higher mental functions are invariably mediated. The source of mediation can be of different types—a material tool, a system of symbols¹, or the behavior of another human being—but it is on *all* occasions a

¹ For Vygotsky mediated means included “various systems for counting; mnemonic techniques; algebraic symbol systems; works of art; writing; schemes, diagrams, maps, and mechanical drawings; all sorts of conventional signs, and so on” (Vygotsky, 1981, p. 137).

sociocultural mediation; a fact which led Vygotsky to state that “the central fact about our psychology is the fact of mediation” (Vygotsky, 1982, p. 166; quoted in Nicholl, 1998). For example, when we eat we use a knife and fork (material artifacts), when we write do it through the use of a pen, pencil, or computer but, besides this material mediation, when writing we also use a psychological tool: language (Luria’s ‘tool of tools’). Most, if not all, of our actions—including thought—are mediated by some type of cultural artifact.

Hence, it is the ability to function at the level of mediated higher mental processes, with the artifacts that are historically and culturally transmitted, that distinguishes human beings from other animals.

This formulation has enormously important consequences. It implies (1) that every time we act we do it through the use of cultural tools that are social, pre-exist us, mediate our actions and transform and restructure our ‘nature’ in the process (see Lock, 1996; Kozulin, 1990). For example, having a language changes the way in which we perceive reality. Words expand our consciousness but also limit us as we can only fully experience and understand that which we have words for. It also implies (2) that artifacts do not simply facilitate certain mental functions, they shape and transform them. By the same token, it indicates (3) that all psychological functions begin and to a large extent remain culturally, historically and institutionally situated and are context specific (Cole & Wertsch, n.d.). Moreover, it presupposes (4) that the mind is distributed. It is not exclusively in our heads but also in the artifacts that mediate our actions. Higher mental functions include the biological individual, the cultural mediational artifacts and the sociocultural context (see Bateson, 1972, pp. 318-320). Finally, it presupposes (5) a reformulation of the rationalist principle, that is, rather than the usual ‘from thought to action’, for Vygotskians the principle is from ‘action to thought’.

In his work Vygotsky focused mainly on one type of mediator: signs and symbols. He had a particular interest in language and on the relationship between thought and speech. Vygotsky argued that speech is first a social activity, because its primary function is communication (Benson, 1995). As the child masters the language he/she develops 'inner speech', that is, he/she transforms this social activity into an individualized activity. Language, then, is a mediator for thought, with it "[t]hought becomes verbal, and speech becomes rational" (Vygotsky, 1962; quoted in Benson, 1995).

Until now we have seen how, according to Vygotsky, higher mental functions are always social, mediated activities. Now we need to see how they become individual. Vygotsky argued that this happened through a process of internalization. Put in very simple words he argued that as the child practices, in social settings, the activities that constitute the higher mental functions, he/she increasingly masters them and finally internalizes them². Vygotsky formulated this principle as the "general genetic law of cultural development" (Vygotsky, 1981, p. 163).

We can summarize that thought, consciousness and intelligence are at their core a social process. This process gives rise—through internalization—to private instances, which can then transform the social. However, it is important to keep in mind that, for Vygotsky, the social is above the individual, one can say, so to speak, that the social is the norm and the individual the exception.

And, what is the role played by artifacts? For Vygotsky, the social is composed of artifacts, these artifacts are part of the context and they affect psychological processes. Thus, every time we act (including in thought) we do it through the use of artifacts. Artifacts mediate both the social and the

² As a side note it is important to stress a great paradox of the internalization process: The child masters his/her social environment by submitting to it.

private. Again here, the social has supremacy over the private, for if the culture in which we are brought up does not possess certain artifacts we will not, as individuals, be able to utilize them or the higher mental functions they facilitate.

Thus, the social character of higher mental processes and their artifactual mediation cannot be separated, they are mutually constitutive. The study of one implies the study of the other. This is central to an understanding of Vygotsky.

*Section Two – Marshall McLuhan and the psycho-social impact of media:
Artifacts as extensions; Individual thought becomes social*

The context in which Marshall McLuhan developed his studies is in many ways similar to that of Vygotsky. Much in the same manner that Vygotsky argued that the quantitative study of psychology, read experimental psychology and behaviorism, were not sufficient; McLuhan argued that the study of media as mere carriers, whose only effect was to create numbers, or mass audiences, was inadequate.

The similarities between both scholars do not finish here, both McLuhan and Vygotsky dedicated their lives to the study of the relationship between individuals, artifacts and their psycho-social impact. For both scholars it was clear that there is a mutual shaping taking place, that is, artifacts are not simply instruments that are used by human beings, but their use produces changes in psychological processes. McLuhan formalized this relationship in the sentence “we become what we behold... We shape our tools and afterwards our tools shape us” (quoted in Lapham, 1994, p. xxi).

Not to say that these two scholars focused on the same exact issues, for Vygotsky was a developmental psychologist and McLuhan a communications theorist. The difference is not small, but for the purposes of this paper—to see the role of artifacts in cognitive science—the differences in final goals are less relevant than the similarities in their lines of thought.

I am not sure if McLuhan was acquainted with Vygotsky’s work. In fact, as far as I know there is not a single reference in McLuhan’s work to him. However, I believe that McLuhan would have been enthusiastic about Vygotsky’s theories, for his own work seems to pick up where Vygotsky’s stops, and then take it a step further.

McLuhan's primary interest was the psycho-social impact of the use of different artifacts. He focused mainly on representation systems—orality, writing, print and electronic media—but through his work McLuhan's research touched upon many other artifacts, such as cars, clothes, clocks, money and so on.

His view of language is in line with that of Vygotsky. While Vygotsky argued that through language "thought becomes verbal and speech becomes rational" (Vygotsky, 1962; quoted in Benson, 1995); McLuhan argues that "[i]t is the extension of man in speech that enables the intellect to detach itself from the vastly wider reality. Without language... human intelligence would have remained totally in the objects of its attention" (McLuhan, 1964, p. 79). From here we can conclude that McLuhan, as well as Vygotsky, saw language (itself an artifact) as mediating our relation to the world and, in a sense, privatizing or individualizing a social process.

However, McLuhan goes beyond the mediating factor. He posits that all artifacts—whether language, or laws, or ideas and hypotheses, or tools, or clothing, or computers—are extensions of the physical human body or the mind (McLuhan & McLuhan, 1988, p. 93). As such they extend some of our senses, and throw others into the background, creating an imbalance in the ratio of senses: "if a new technology extends one or more of our senses outside us into the social world, then new ratios among all of our senses will occur in that particular culture" (McLuhan, 1962, p. 41). This is one of the central ideas of McLuhan's thinking. Every new medium—or artifact—extends one, or more, of our senses. By giving one of the senses a place of increased prominence it creates an imbalance in the previous status quo, and creates new modes of experiencing the world. For example, McLuhan argued that print creates visual cultures, cultures where the eye takes a dominant place. Consequently, in literate cultures the mode of experience favors the explicit, the rational, the uniform and the sequential (ibid, p. 57).

The shift from artifacts as mediators to artifacts as extensions has great implications for theorizing the role of artifacts. Vygotsky's view of artifacts as mediators places a great 'passiveness' in the artifacts themselves³. McLuhan saw media/artifacts not as mere tools (psychological or material) that mediate our actions and thoughts, but as active metaphors that translate our experience. Moreover, for McLuhan media/artifacts are environments⁴. They are ecosystems that favour certain social dynamics, certain social patterns of organization and certain modes of experience. An artifact shapes the relation between all the things which have been brought together to constitute it. For example, the telephone enabled dominance over distance, however by extending the boundaries of who could speak to whom it also threatened existing class relations, created new forms of courtship, and so forth (see Marvin, 1988, p. 4-5).

The quality of media/artifacts as environments is clearly expressed in McLuhan's projections about and observations on electronic media⁵. McLuhan saw electronic media as extensions of our consciousness and he stated his belief that what had been previously individualized with the alphabet will now return to its original social 'nature'. In *Understanding Media* (1964) McLuhan writes,

During the mechanical ages we had extended our bodies in space. Today... [with electric technology] we have extended our central nervous system itself in a global embrace.... Rapidly, we approach the final phase of the extensions of man—the technological simulation of consciousness, when the creative

³ In later developments of 'sociocultural psychology' Michael Cole (1996) has given greater attention to the characteristics of the artifacts themselves. Cole discusses the 'dual nature' of artifacts, that is, their conceptual and material nature, and concludes that "[a]rtifacts are always involved in a dual mediation, with the nonhuman world and with other people" (Cole, 1996, p. 331)

⁴ It was this 'environmental' aspect of media that led McLuhan to affirm that 'the medium is the message', i.e., " 'the medium is the message' because it is the medium that shapes and controls the scale and form of human association and action" (McLuhan, 1964, p. 9).

⁵ Vygotsky died in 1936, too early to see the joining of material and psychological artifacts, therefore it is impossible to know what he would have said about it.

process of knowing will be collectively and corporately extended to the whole of human society (pp. 3-4).

One may agree or disagree with the promise of a 'global consciousness' or even with the 'extension of the nervous system', but independently of that, what is necessary (and important) to acknowledge is the power of electric media and its networks to re-connect people in new and innovative manners. In a way, what McLuhan recognized was the power of electric media environments to reconnect the private thought in a way that brings it back to the level of the social.

This thesis is supported by Derrick de Kerckhove, a former student and collaborator of McLuhan and currently Director of the McLuhan Program in Culture and Technology at the University of Toronto, whose research on Connected Intelligence led him to the conclusion that "[i]t isn't thought that is interior language, it is language that is externalized thought shared by many minds" (de Kerckhove, 2000).

The emphasis on the environmental character of media is important for it bears a direct relation to 'sociocultural psychology' and cognitive science. Vygotsky argued that meaning came from the sociocultural setting, that is, it is the specific sociocultural setting that makes 'meaning meaningful' (see Kozulin, 1990, p. 114). Hence, meaning is socially and culturally bounded, which implies that the practices of a culture only have that *one* meaning while inside that *one* culture. McLuhan, on the other hand, argued that "the 'meaning of meaning' is relationship" (McLuhan & Nevitt, 1972), i.e., meaning relies on a meaningful relationship between two (or more) nodes rather than on a culture. From McLuhan's perspective meaning arises in any environment where there is connection, thus, McLuhan's 'social' is not only broader but also much better fitted to today's connected world.

In short, if using Vygotsky's terminology we would say that electronic networks are simultaneously a material and psychological 'cognitive technology' (see Lock, 1996). Using McLuhan's terminology we take it a step further, we say they are extensions of our mind and body. And by extending us to the outside, they bring back to the social that which was previously private. The new environments created by electronic media are environments where private/individual consciousness and thought extend into the social sphere to create new connections with other entities.

*Section Three – Actor-network theory:
Artifacts as actors; Knowledge is relational*

Even though there are very few direct links, there are ways in which Actor-network theory⁶ (ANT) picks up where McLuhan left us. Both reflect the need to see artifacts as environments, rather than passive tools, and the need to observe the nature of the relationships between the individual and the social. However, ANT goes beyond McLuhan in two important ways: First, it reclaims the necessity of studying the process of the shaping of the artifacts (both McLuhan and Vygotsky emphasized the mutual constitution between artifacts and individuals, but neither studied the process of the formation of the artifacts themselves). I bring up this point, not because I want to engage in a discussion of 'how artifacts are created', but rather because the oblivion to which this process has been relegated hinders a complete understanding of the role played by the artifact itself. The second point in which ANT goes beyond McLuhan follows from the first, and consists of a leveling of the status, and subsequent dissolution of boundaries, between the human and non-human in the construction of the social. ANT's main proposition is that the split between the natural and the artifactual is artificial in itself. Thus, Bruno Latour argues, Modernity relies on the "complete separation between the natural world (constructed, nevertheless, by man) and the social world (sustained, nevertheless, by things)" (Latour, 1993, p. 31). ANT tries to reconnect these two spheres, not through the construction of bridges, but rather through the observation of the multiple networks that compose the social, and that, in turn, are composed of entities (human and nonhuman) which possess the same status.

By doing this ANT proposes a new perspective in which action, meaning and, to a large extent, cognition are relational, rather than individual or social.

The enterprise in which ANT is engaged is not an easy one⁷. At its core ANT tries reconcile the categorical divisions that Modernity has created: nature, society and artifacts. As aforementioned, this reconciliation does not translate into the making of bridges between both, but rather to (1) the blending together and the leveling of the status of the entities involved in both, and (2) the study of the social as a set of distinct networks. It is within these networks, these sets of relationships, that we can understand the mutual constitution of the different elements. Human and nonhuman can only be understood one through the other. We cannot understand people without their artifacts, nor can we understand artifacts without the context of people.

What then is the social made of? For ANT the answer is clear: “[t]he social is materially heterogeneous” (Callon & Law, 1997, p. 167). This means that the social is constituted of bodies, but also of technologies, texts, money, buildings, and so forth. Thus, ANT asks, why do we consider some of these ‘materials’ to be passive tools? If we all agree (as I am sure we do) that the social is materially heterogeneous, then we should (but I am not so sure we do) also agree that “[a]ll these elements and materials participate in social ordering” (Ibid, p. 168)—that is, reality is of a ‘hybrid nature’—which would then imply that we also agree (and here certainly many of us don’t) that all entities are potential actors⁸.

⁶ Actor-network theory is being developed within the science studies field. Its main proponent is Bruno Latour but others, such as Michel Callon, John Law and Steve Woolgar are also known for their work in this area.

⁷ In fact, for a full understanding of ANT it would be necessary to write much more than will fit in the space allotted in this paper. Thus, here I will focus only on the topics which have a direct relevance to the thesis I am proposing, that is, the recognition of artifacts as actors, and the subsequent shift to understanding cognition as a relational process—rather than an individual or social one.

⁸ This constitutes a very simplified explanation of a much larger and complex argument, in which Latour differentiates between *actants* and *actors*. An *actant* being that the ‘thing’ itself with its unspecified nature, and an *actor* being the ‘thing’ plus the competencies which are attached to it (Akrich & Latour, 1992, p. 259; quoted in Stalder, 1997). However, for our purposes it is only necessary to grasp the main idea, i.e., artifacts possess, in and of themselves, agency.

For Actor-network theory actors are “entities that *do* things” (Latour, 1992, p. 241). But agency in ANT is, if not an antonym, then at least, less than intuitive in regards to common sense. Usually when talking about agency we discuss human beings. Some philosophers, like Dennett (1996) extend agency to other biological entities, such as cells, but even then it is discussed as a property of living things. For ANT, however, artifacts/objects possess the potential for agency. This agency derives, to a large extent, from the fact that they *exist*. By existing they transform, or at least, have the potential of doing so. Linking it back to Vygotsky, we could say that much in the same manner that Vygotsky goes ‘from action to thought’, Latour goes from ‘existence (in relationships) to essence’⁹. It is an actor’s existence that defines his/her/its essence. Let’s take the example of newborn babies. Newborn babies are immersed in an environment of actors, which are pretty much independent of his/her will (see for example Harkness & Super, 1996). These actors—, parents, diapers, pacifiers, and vaccines, et cetera—act upon him/her, and can to a certain extent determine who he/she will grow up to be, but they do this independently of his/her awareness, at least initially.

By the same token, we cannot use a pacifier as a diaper, that is, the objects themselves have competencies which must be taken into account. These competencies give them agency. So, first, there are the objects and the action of the objects, then there is awareness of the objects; or in other words, first there is existence, there is being (both of the babies, and of the objects that surround them) and then there is essence (what each entity is). Thus, there is no such thing as essence because what entities are is determined in their total existence (see Latour, 1991, p. 115)

⁹ This notion is attributed to Jean-Paul Sartre who once stated that ‘existence precedes essence’ (quoted in Latour, 1993, p. 86).

The notions of agency and actors are better understood when inserted in the context of networks, a concept which I will describe forthwith. Succinctly networks are sets of heterogenous relationships which connect, and in the process of connecting define, different entities¹⁰. By being constituted of humans and nonhumans, networks are hybrid in nature, i.e., they are/create beings which cross the boundaries of nature and culture. Latour (1993) states that the reason why it is important to bring the study of networks forward is because networks, just like reality, "are neither objective nor social, nor are they effects of discourse, even though they are real, and collective and discursive" (p. 6). To support this argument Latour gives the example of the nature of scientific facts, and says,

Yes, the scientific facts are indeed constructed, but they cannot be reduced to the social dimension because this dimension is populated by objects mobilized to construct it. Yes, those objects are real but they look so much like social actors that they cannot be reduced to the reality 'out there' invented by the philosophers of science (Ibid, p. 6).

In a sense, everything is entangled in a network. This is because entities (human, nonhuman and textual) are neither an 'essence' nor solid. Their boundaries are not given, but rather defined by their relationships. Reality is the result of a process of composition, of transformation and of negotiation among different actors¹¹. Thus, entities are sets of relationships that materialize in the form of networks.

The entity is co-extensive with the network, they constitute each other mutually (Callon & Law, 1997, p. 170). Thus, the network is not static or rigid but rather dynamic and interactional. The identity of an entity is dependent on

¹⁰ This definition of networks seems to be in accordance with McLuhan's definition of meaning: " 'the meaning of meaning' is relationship" (McLuhan & Nevitt, 1972); and with Bateson's definition of information: "information is a difference that makes a difference" (Bateson, 1972, p. 315).

¹¹ Again here we see similarities with Vygotsky and McLuhan. The entities cannot be separated from the context (Vygotsky) for the networks are environments in themselves (McLuhan).

the shape of the network that supports it. And that is what allows me, for example, to be a student while at the university, a daughter when at home in Portugal, or an expert in communications when presenting a paper at a conference.

I would like to end this section with an example, that will bring these concepts together, and show their implication for cognitive science. My example is taken from Latour's *Pasteurization of France* (1988) in which he describes the making of Pasteur-the-great-researcher. Latour shows how Pasteur's identity and his work were nothing but a network of heterogenous elements. He demonstrates, through careful analysis, how Pasteur's work depended on the 'Pasteur-network' which was constituted of "laboratories, domesticated strains of bacteria, notebooks, statistics. ... the journalists who witnessed Pasteur's spectacular experiment... the French electors Pasteur sought to convince" (Callon & Law, 1997, p. 169), and so forth. Thus, what until now was considered a perfect example of the geniality of an individual at a cognitive level, can now be seen as the result of a network of the concerted action of heterogenous actors that constantly shaped and modified each other. Pasteur's knowledge (or his discovery) is not the result of an only individual cognitive process, nor is it exclusively the product of social cognition, it is the outcome of a series of relations between different actors (human and nonhuman).

Section Four – Conclusion:

How social is the social? Rethinking the nature of artifacts in cognitive science

How social is the social? Depending on how we see the 'nature' of artifacts our attitude towards the nature of cognition will vary. *Hence* in this paper we started off with the notion that artifacts are mediators: artifacts are intermediaries between a sociocultural reality and us as individuals. In this position we saw that (human) cognition was fundamentally and originally social (just like the artifacts themselves): 'action before thought'.

The second position we examined looked at artifacts not as mediators, but rather as extensions of the senses. Thus, here the social still prevails, but it does so as an extension of the private; it is the private that 'invades' the social and not the other way around. McLuhan takes that which Vygotsky privatizes—actually that which literacy privatizes in a McLuhanesque perspective—and brings it back to the realm of the social. Cognition is no longer exclusively mediated by artifacts, it is extended through artifacts, and it is brought back into the domain of the social by these same artifacts.

The third perspective analyzed is the most extreme of all. For Actor-network theory artifacts are actors, thus they possess some agency. It follows that cognition is no longer mediated or extended by artifacts, it is rather negotiated with them. Thus, knowledge becomes relational, inserted in networks of meaning that are in constant state of change.

I believe that to a great extent the shifts we see in the role of artifacts are due to the increasing role that technologies play in our lives. Computer networks on one hand potentially facilitate the creation of shared social spaces, on the other, they take to an extreme the relational character of information and, by extension, that of cognition.

None of the positions stated above has remained static, Vygotsky's line of argument has been developed by preeminent scholars such as James Werstch or Michael Cole. Of particular interest is Cole's (1996) increased concern with the nature of artifacts, as being part of the mediation process; and his attention to the distributed character of cognitive processes.

McLuhan's theories have also been developed in a series of ways, of particular interest is the work of Derrick de Kerckhove on Connected Intelligence (1997). Connected Intelligence is a process of focussed self-organization, which means that the self-organizing principles operate under the guidance of the common focus of the participants. CI is, in a sense, a metaphor for networking. CI works like a network in which it is necessary to keep the flow—that is, its speed, direction and nodes—flexible and open. Connected Intelligence tries to develop eco-sustainable solutions to local problems, by using the 'intelligence', the resources of distinct individuals. It is an approach based on distributed social intelligence.

ANT is the most stimulating but, simultaneously, most problematic of the above described positions. It is exciting for it allows us to take a new look at social organizations and dynamics, and also at cognitive processes. Cognition and action are no longer a question of essence (which leads into all sorts of dualisms), but one of relations. Thus, there is an assumption of symmetry between all actors. And this is where I think ANT's metaphors break, and becomes problematic. By putting too much emphasis on the symmetry of the relationships, ANT loses the particularities of each actor. And on this point I subscribe to Lucy Suchman's position, who states that it is necessary to "develop a discourse that recognizes the deep mutual constitution of humans and artifacts *without losing their particularities*" (Suchman, 2000; emphasis in the original). Suchman goes on to say that it is necessary to acknowledge the interrelationships between humans and machines, "[t]he problem is how to understand our differences differently" (Ibid).

I subscribe to most of the perspectives expressed in this paper. However, I believe that in isolation none of these theories fully accounts for the nature of the social—and the consequent role of artifacts—and thus they cannot account for the nature of cognition either. The perspective of artifacts as mere tools, or even environments, is clearly insufficient for it does not give credit to the extremely important role artifacts play in our development, both social and cognitive. The opposite position, that is, the total leveling of status between artifacts and human beings, loses their particularities, and is therefore also insufficient.

The solution may lie in the combination of these different perspectives, a multi-disciplinary approach to cognition. But it will also lie, as Lucy Suchman puts it so well, in finding a new language to talk about cognition, for both persons and artifacts. We have to shift from a language that focuses on separation, disembodiment and isolation to one that focuses on relatedness and relationships (Suchman, 1997).

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