Culture and Organization

ISSN: 1475-9551 (Print) 1477-2760 (Online) Journal homepage: http://www.tandfonline.com/loi/gsco20

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To cite this article: Pablo Rodriguez & Javier Blanco (2016): Organization and information in Simondon's theory of individuation, Culture and Organization, DOI: 10.1080/14759551.2016.1240745

To link to this article: http://dx.doi.org/10.1080/14759551.2016.1240745

CULTURE AND ORGANIZATION, 2016
http://dx.doi.org/10.1080/14759551.2016.1240745

Routledge
Taylor & Francis Group

Organization and information in Simondon's theory of individuation

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ABSTRACT
This article explores the notions of organization and information in Gilbert Simondon's theory of individuation. It confronts these notions with ideas from cybernetics and especially Alan Turing's work. The 'universal machine' opens new ways of understanding the relations between humans and machines, and highlights an *impasse* in Simondon's theory. These concepts act as precursors to post-structuralist philosophy and Gilles Deleuze's oeuvre.

ARTICLE HISTORY
Received 27 October 2015
Accepted 20 September 2016

KEYWORDS
Simondon; information; transindividuality; cybernetics; technical ensembles

Organization, information and individuation

Gilbert Simondon's general theory of individuation addresses subjects such as, *singularity*, *event* and *difference*, whereby he is a precursor of French post-structuralism. He considered the main scientific theories of the century, filling in the gap between the 'two cultures', denounced by Charles P. Snow. His theory of individuation gave rise to an ambitious *philosophy of technology*, which is radically different from others. He focused on the mutual lack of understanding between technology, science and philosophy. And among these, probably the most important gap concerned the sciences and technologies of information.

The word 'information' appears in the title of his: *L'individuation à la lumière des notions de forme et d'information* (ILFI). He stated: 'information is the formula of individuation, a formula that doesn't preexist individuation' (Simondon 2005a, 31, our translation). Following Barthélémy (2014, 214, our translation), 'we can consider the notion of information – as construed by Simondon, as the center of a "notional reform" – and as his greatest theoretical challenge'. Simondon's information theory acts here as the basis for a renewed approach to organization, especially concerning the notions of 'process' and 'complexity'. Our aim is to expose the links Simondon established between organization and information through his critical dialogue with cybernetics and systems theory.

Simondon's contribution lies in his theory of individuation. On the philosophical level, he anticipated some fundamental issues of post-structuralist philosophy, mainly found in the ideas of Gilles Deleuze. Simondon questions ontological distinctions, in order to build a theory of becoming. Instead of structures, he talks about operations; instead of identity, he looks to differential relations. He anticipates the emergence during the 1960s of Ludwig von Bertalanffy's General Systems Theory. Simondon modeled through his 'amplification processes' the notions of process, a theory of complex systems and the conception of information as an emergent systems property. On the technological level, he rejected technological reductionism and the view of information as a 'black box' (or a new kind of substance, acting as an input to some technical system).

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According to Simondon, individuation and within it the processes of organization and information consist in amplifications that reduce tensions without canceling them. The theory of individuation is a theory of change and of becoming. Organization and information are not the mere attributes of entities, but are modalities of change that occurs on all levels of existence. The classical cybernetic and systemic idea that information entails a certain degree of organization, Simondon claims that organization arises as a special kind of amplification of information, considered not as the transportation of a substance or signal, but simply as transformation generated by a structure 'eager' to receive it. There is neither organization nor information without tension or conflict. If such tensions or conflicts reach a stable state, organization/information ceases to be. Organization and information require metastable equilibrium.

All phenomena of organization or information require indetermination as opposed to deterministic theories, which sooner or later fall into essentialisms. The notion of organization thus is linked to the theory of information on the philosophical, scientific and technological levels.

A philosophical critique of information

'Information is information, not matter or energy. No materialism which does not admit this can survive at the present day.' This well-known statement of Wiener (1950, 132), one of the 'founding fathers' of cybernetics, points to one of the main problems posed by the definition of information: its relation with matter and energy. Current usages of the term tend to subsume information under a cloak of immateriality. For instance, the reduction in size of storage media has come hand in hand with an exponential growth in storage capacity. While Wiener seems to agree with the hypothesis of immateriality, he also affirms that we need a new materialism. Friedrich Engels stated that each time has its own materialism. Ours' could be the materialism of information, which implies a different kind of materiality related to transmission, codes and machines.

The relations between matter, energy and information were the subject of debate during the Macy conferences between 1946 and 1953 (Heims 1991; Breton 1992; Dupuy 1999; Hayles 1999; Triclot 2008; Hui 2015). Simondon had access to some of the unpublished proceedings, which he used to develop his theories. We find here a tension between at least two different notions of information: one which considers information as a kind of entity that unfolds in forms of materiality, such as in living, social or artificial beings; and another which seeks to subsume information theory under physics, mainly establishing an analogy with thermodynamics through the concept of entropy. Wiener argues that living and artificial entities can be understood following a model of message transmission (emitter–message–receiver and their companions: code–channel–context). This concept of information involves an extrapolation of technological schemes originating in computer science and telecommunications, to non-technological frameworks, including living and social phenomena. And takes distance from Claude Shannon's mathematical theory of information and Donald MacKay's qualitative theory. Both then and now, the notion of information is not unified. Attempts to produce a unified theory have failed to deal with the variety of disciplines and contexts in which 'information' has to make sense. I believe that Simondon's notion of information is uniquely tenable.

Simondon finds in information a tension between matter and energy. As Hui (2015, 35–36, our translation) says:

> Simondon defines the individual as the result of three conditions: the energetic condition, the material condition and the – in general, non-immanent – informational condition. The informational condition is what enables the resolution of the tension between the material and the energetic conditions.

Simondon's examples from *ILFI*, about the acquisition process of form undertaken by a brick or a crystal, are taken from technology and physics and are aimed at de-centering the analysis of information. In-formation processes, according to Simondon, are those in which matter gains form. In particular, there are two elements that transform the problem of information in Simondon's work into a

philosophical problem, rather than a scientific or technological one. The first fact that information, as well as individuation, expresses a process of becoming, instead of rendering a state of being. One cannot define information by abstracting it from its context and operational character. Simondon asserted (2010, 159, our translation) that: 'information is not a thing but the operation of a thing that arrives into a system, producing a transformation'. Information does not 'belong' to the emitter as in a communication model, but rather it occurs within the receiver, with the implicit understanding of 'receiver' not as someone who receives something but as 'any reality that does not possess entirely in itself the determination of its future course'.

In Simondon's notion of information, there is an informational level of explanation in all domains: physical, living, psychical and collective (as developed in ILFI and also, for the technical domain, in *Du mode d'existence des objets techniques* MEOT). But none of these domains has preeminence over the others. This non-hierarchical approach, contrasts with cybernetics, where the technical perspective seems to occupy a privileged position. Despite having its origin in science and technology, information is for Simondon a concept with a clear philosophical scope. Opening the 'black box of information' helps to extend its meaning toward the notion of 'organization' and to articulate both concepts in the renewed philosophical language of post-structuralist French philosophy.

As Bardin (2015, 31) wrote:

> If the program of cybernetics consists in expanding a technological paradigm to the biological and social systems, Simondon's attempt seems rather the opposite. He aims to expand a biological and/or psycho-social paradigm of communication to the physical and technological fields, relying on what quantum physics associated to thermodynamics allows him to think, i.e. the quantic nature of all systems and the non-deterministic characterization of all processes, against the essentially deterministic nature of cybernetics' concept of information.

Information can be said in many ways

Like 'being' in Aristotle, 'information' in Simondon can be understood in many different ways, some of them similar to cybernetics, some not. According to Simondon, the concept of 'information' is a *dubbleganger* for the notion of form, as in: 'in-formation'. Both concepts – 'form' and 'information' – come from the technological: the first from the times of ancient Greece; the second, from the birth of cybernetics. For Simondon, it is incorrect to state that form is given to matter; neither does matter lack form, nor does form lack matter. The hylemorphic (*hyle*: matter and *morphos*: form) scheme, usually attributed to Aristotle, is hereby rejected[1]. *ILFI* begins with an extensive analysis of the process of making a brick, centering on the way in which clay becomes uniform and the molecular tension inside the mold plays itself out. These are practical examples that question the differentiation between form – based on the platonic *eidos* – and matter.

> In other terms, what the concept of form lacks is precisely the possibility of conceiving the actual metastability of systems, their tendency towards producing transductive amplification, rather than (apparently) ensuring a long duration with no effects. For this reason Simondon turns his attention to the emergent concept of information, since it allows for the understanding of 'formation' as a process concerning a dynamical system. Also for cybernetics a system (whether physical, biological, social) is a complex system, each element of which is related to the others and with the system as a whole, but it is also characterized by self-regulatory processes. Thus the system is conceived as permanently active, its equilibrium 'dynamic' rather than 'stable'. (Bardin 2015, 24)

Information is also thought of by Simondon as a process of amplification; here, information means communication between different orders of magnitude (2005a, 33). There are three kinds of amplification: transductive, modulating and organizing. Transduction, modulation and amplification are names coming from telecommunication engineering, related to the handling of codes and signals.

Transductive amplification presupposes that information originates in the receptive structures of the transition from a metastable state to a stable one. Contrary to transmission, in transduction, the receiver has to undergo a complete transformation. In physical terms, transductive amplification has an activation threshold, which determines (instantly) whether the transduction takes place or not. Simondon (2010, 174) calls transduction 'an instant impulsion to the future'. A micro-structure

functions as a germ for macro-physical that generates a change in magnitude, from elemental to collective (171). The processes of crystallization and brick molding are examples of transductive informational amplification. Considering the domain of the living, the nerve impulse is an all-or-nothing (quantic) example of transduction. On the psychical level, instinctive activities are examples of transduction. Finally, on the psychosocial level, rumoring is a case of transduction, since it needs the metastability of the receivers, that is, their uneasiness or inquisitiveness, to propagate.

Modulating amplification is obtained 'by taming transductive propagation, that is, by mastering it and stably feeding it in order to make it produce and work within regular conditions' (Simondon 2010, 165, our translation). Moving from a metastable to a stable state occurs at a fixed point, which does not imply a change in the whole structure, as in the transductive case. Instead of quantic thresholds, here we find polarities within input–output positions. These polarities are the product of an outside intervention, that is, the reality is not transformed by its own metastability. One could say that this is not a case of intrinsic metastability, but rather a metastability driven by an external energy source. There is no need to access the complete structure information transfer to occur. In modulation, there is a 'fixed iteration of the past in the guise of conservation' (174, our translation). We are dealing here with 'macrophysical structures carried by a weak energy' that 'govern the becoming of a perpetually renewed population of microphysical elements' (171, our translation). Simondon provides the relay race as an example. The first runner must run the whole distance and spend all her energy before the second runner begins her sprint, and hence spends her own reserve of energy. The performance of the first runner constrains what the second can do. In technological terms, the transistor is a modulation device. In the living realm, the paradigmatic cases are the processes of self-regulation. Whereas instinctive activities were examples of transductive amplification, abstraction and generalization, produced and controlled by formal reasoning, are modulating activities because they integrate a variety of new elements in older structures.

A more complex example, which illustrates the philosophical consequences, comes from the social sphere; and from ethics based on the distinction between norms and values. Simondon identifies (2010, 170, our translation) in religions and morals a project to achieve 'a limitation of activity in permanent regime'. Religious values presume a rigid code and a ritualized action program, which constrains social activity. And moral norms 'are a scale of values, which constitute … positive or negative magnitudes' (169, our translation). Moral norms are a case of modulation. To modulate is not to impose a code, but rather to establish a possible scope for action, which Simondon calls 'polarization'.

Discussion within cybernetics

The third sense of 'information' refers to cybernetics, mainly during the Macy conferences. Simondon identifies two different notions of information: (1) Wiener's, according to which information is what opposes energy degradation and is measured in terms of the probabilities of states of a given system (and hence covering Shannon's notion) and (2) the assumption that information presumes regularity and predictability, since in no other way could a signal be modulated and transmitted. To combine these notions, Simondon moves from information towards signification: 'in order to be received, signals need to meet *already given forms*, and relative to them, they are *meaningful*: meaning is relational' (2005a, 223, our translation).

In this way, Simondon reconsiders two of the three conceptions present at the Macy conferences: (i) information related to transmission, in line with C. Shannon and L. Brillouin; (ii) information related to signification, in line with D. MacKay. And the third, which will be addressed later in this article, information related to programming, in line with A. Turing, A. Kolmogorov and G. Chaitin (Hui 2015).

Simondon wonders whether probable states can be considered to be carrying information or not. He links the two senses of information in a kind of balance that could be considered, in his own terms, *metastable*. In-formation is not just a relation between form and matter, you must also explain message transmission. But confronted with Shannon's concept of information as message transmission, Simondon asserts form-matter, as mediated through *Gestalttheorie*. As Barthélémy (2005,

116, our translation) says: 'Simondon detaches information from the technological transmission of a message to make it a "shape-taking process" and a genesis; as such, universalizable "from below" by physical individuation.'

In a metastable balance, some potential is preserved for the later evolution of the system, in this case, the information system. Neither *Gestalttheorie* nor information theory had such a consideration. In both cases, there is an active and a passive term: on the one hand, form and the emitter position, and on the other hand, matter and the receiver position. Acquisition of form, or correct reception of a message, is bounded by a start and end point. The goal, when reached, confirms that there is information in the system. On the contrary, considering information as becoming presumes that the processes do not have a beginning or end, and that they are open for the unexpected. Simondon points out that talking about information processing, as if information was a thing and not a relation between things in perpetual becoming, is the result of assuming the hylemorphic scheme. Given that information is found in probable states, subject to limited variation, the distinction between passive and active states is untenable:

> Information is halfway between pure chance and absolute regularity […] information is not a kind of form, neither a set of forms, it is the variability of forms, the intake of a variation upon a given form. It is the unpredictability of a variation, not the pure unpredictability of any variation. We shall then distinguish three terms: pure chance, form and information. (Simondon 1989, 137, our translation)

An information theory needs to take meaning into account, but how (Hayles 1999, 54)? Must we avoid the difficulty posed to measuring information that taking the singularity of each possible receiver into account poses? The semantic level of the message, that is, what can be socially understood, would not be quantifiable. Following Hayles (56, his emphasis), 'whereas Shannon and Wiener define information in terms of what it *is*, MacKay defines it in terms of what it *does*'. And he goes on: 'Making information an action, links it with reflexivity, for then its effect on the receiver must be taken into account, and measuring this effect sets up the potential for a reflexive spiral through an infinite regress of observers' (56–57). Indeed, for Simondon, information is not a thing, it is an operation, it happens within the receiver and not within the emitter, and it is offered to a variety of receivers. In 'Form, information and potentials' (1960), Simondon asserts that a qualitative theory of information requires 'a non-probabilistic term' (2005b, 542, our translation), which defines the 'ability to get through, to animate, and to structure a varied domain'. Simondon 'assumes an open series of receivers: [where the] information tension is proportional to the capacity that a pattern has, to be received as information, by some receivers, not defined in advance' (544, our translation). Information is not a question of semantics, of a set of relatively stable meanings that can be contextually interpreted; rather, it is that the receiver who must be metastable. Referring to information as potentials, and not as form, highlights that emergent signification requires something that is not saturated, that is, is incomplete. This is not a failure, but, on the contrary, the ability of becoming. In this respect, post-structuralism, is anticipated by Simondon. It is, in fact, all is about replacing the term 'structure' by 'operation' and 'identity' by 'differential relation' (Bardin 2015, 25). This involves complying with cybernetic principles: an information machine is not one that emits or receives messages, but a process which keeps 'a certain margin of indetermination' (Simondon 1989, 11, our translation), referring to Heisenberg's uncertainty principle. Non-deterministic and non-probabilistic, Simondon's theory is:

> apt to describe metastable systems by highlighting what in their transductive-operational functioning exceeds any 'coded' homeostatic functioning: this surplus is precisely the indefinite re-emergence of information within the systems which, at the same time, it constitutes. And this is true at any scale one would consider the individual as a system (Bardin, 31).

Of men and machines

Turning to A. M. Turing's reflections on the possibility of mechanical or effective information processing, computers can be taken as an example of the way information can be understood as an

operation. Information, according to Turing, exceeds Shannon's notion, although this idea was not thematized by Turing himself. Though Simondon did not directly address Turing's work, their conceptions about information and even technical artifacts seem to have some important points in common. These agreements, however, were not acknowledged by Simondon. In MEOT, Simondon claimed that human and mechanical memory are essentially different, since for humans 'the content becomes codification'. That is to say, it can transform future understandings of information, and it can modify the code. According to Simondon, in any machine, 'codification and content remain separated, as conditioning and conditioned respectively' (MEOT, 123). But this involves a misconception about computer power.

A Turing machine is an abstract device, with a given finite alphabet used for both input and output, through an infinite tape, a finite set of internal (mental) states, and rules to operate on this tape defined by a transition function. This function considers only one current character on the tape (perception is limited), and its current state. It indicates whether to move left or right (or to remain on the same square), whether to change the scanned character on the tape, and what will be the next mental state. The process of applying this function to the tape is continued until, if ever, no rule exists for a given state and input. Turing introduces the *computer*, which in this case is a human equipped with pen and paper, who follows the rules specified by the transition table, which encodes the transition function.

Each transition table characterizes a particular Turing Machine, which would take its input from the tape and leave its output, if it ever halts, on the same tape. Turing goes on to construct a *universal* Turing machine (UTM), which takes as its input a tape of some other Turing Machine (i.e. of its transition table). The UTM will then behave as an encoded machine, taking as its input the rest of the tape. One of the main consequences of the UTM's existence is that three categories considered, a priori, as different, that is *machines* (or hardware), *programs* (or software) and *data*, are no longer so. The roles are somehow functional, and they may switch places achieving – in Martin Davis words – a fluidity among them. Hardware and software interchange their places and functions in a transparent way for the user or the programmer, a program is also a datum for an interpreter, and the Turing machine itself can be considered as an interpreter for the transition tables, but also the UTM is an interpreter for the machine encoded in its input tape (Blanco et al. 2011).

Whereas these properties of Turing machines and by extension of any computational system are well known, the extent of their implications is enormous. The intrinsic indiscernibility between program and data, the reflexive properties of a UTM, or a fortiori of a UTM, which takes as first input the codification of another UTM, and so forth, show a rich and malleable framework. These machines maximally realize Simondon's prescription of being indeterminate and able to change behavior according to the information that impinges upon them. But this explanation is absent in Simondon's MEOT, which founders on some misconceptions about what computers can do.

Programs and processes

Simondon's critique of cybernetic self-regulation, applied to social processes, focuses on how machines actually work, and regards automatism as a deficit instead of as a technological advantage. His critique of certain functions, which humans share with machines, such as memory, however, does not take full-fledged digital retention and the ubiquity of algorithms for data manipulation into account. The idea that there is a qualitative difference between humans and machines, which rests on how information is distinctively managed and stored, reflects a conception of machines and mechanisms, which has not yet incorporated contemporary computer technology. Even today, computers are frequently understood in the same way as Simondon did in MEOT. His understanding of computers is in agreement with what has been called the *Lady's Lovelace objection*, which states that a computer can only perform what it has been programmed to do, it can never have an unexpected behavior. If, furthermore, intelligent human behavior cannot be fully captured by a set of explicit rules, then the gap between humans and machines would be safely preserved, no matter

what advances are produced in computing technology or artificial intelligence. As Mathieu Triclot remarks, the question here is about the status of rules, whether they are fixed in advance or they may emerge as regularities of a learning process. Posed in terms of the ontology of programs, the information processing would not be limited to rules established by the program-script, but they could be established during the execution of the program, the so-called program-process. The reflexive properties that the model of Turing machines intrinsically possesses, allows in-formation analogous to what Simondon excludes from machines and reserves for living beings, to exist. In this sense, the informational ontological gap between humans and machines becomes just a question of degrees.

The signification – always partial, always in a process of becoming – of data keeps gathering its form and conceived so, information resembles Wiener's idea of signal or a significant regularity in a field of random structures, than a disembodied symbol. Turing's proposal of constructing thinking machines seems to oscillate between the simulation of intelligent behavior done by a specific program, and the possibility of making a machine capable of learning as a child does. Turing proposes these child-machines as an alternative to – what was later to be called – symbolic artificial intelligence. Both kinds of machines are specific realizations of the same abstract model; there is no ontological difference between them. Reflexive behavior or emergentist positions with respect to knowledge are not contradictory with the deterministic model of Turing machines. On the contrary, the mathematical properties of these machines guarantee that reflexion and emergent rules produced by a learning process are possible in these models. In this sense, information considered not as a thing tied with a pre-existent code, but rather as emerging together with the – variable – code, as Simondon proposes, is justified also within Turing's model.

Organization between individuation and information

The difference between program and process, which involves two different conceptions of information, reappears in the opposition which Simondon establishes between cybernetics as a general theory of information and as a thing, and what he calls *allagmatics*, or the science of operations.

If Turing's machines illustrate Simondon's aims, despite his own (mis-)understandings of them, we can begin to point to a much-needed new theory of information. This theory should integrate developments in the theory of computation with what in the life sciences is called 'information as an emergent property'. And this leads us to consider the particular conception that Simondon has with respect to organization and its relation with information.

In general, Simondon aims to leave behind philosophical reflection based on ontological distinctions (human–animal–machine; organic–inorganic), in favor of ontogenetic definitions, which postulate individuations – physical, living, psychic and collective, instead of essential differences among entities: 'the originality of Simondon's theory of ontogenesis always resides in conceiving individuation as an amplification process, in tension between two orders of magnitude, either in the case of crystallization, or the case of photosynthesis, or that of invention' (Bontems 2008, 297, our translation). Considering information as amplification, and as an emergent property, differentiates Simondon's position from cybernetics where information is thought of as an equivalent to organization.

> Simondon takes the concept of organization from a specific sector of technology, and in particular from electronics but he uses it as an interpretative paradigm aimed, in the first place, to the promotion of a critical comparison between different disciplines in order to ultimately attain a much needed *conceptual axiomatization of knowledge*. (Carrozzini 2011, 73–74, his emphasis, our translation)

Early in the introduction of ILFI, just before the claim that 'information is the formula of individuation', Simondon writes that (2005a, 31, our translation): 'Information is what transforms unresolved incompatibilities of a system into an organizing dimension … ; information assumes the phase-shifting of the system, since it presupposes a former pre-individual state that individuates, according to the

discovered organization.' This means that information, as individuation and amplification, is not a measure of organization but rather its generator. From this assumption, Simondon (2005a, 159, our translation) dismantles the distinction between life and matter in favor of an ontogenetic process, which links physical and life's individuations. Since matter is not formless, it can be claimed that the 'physical world is highly organized'. In fact, and here Simondon perceived clearly what would eventually become one of the main issues of molecular biology, 'the elemental levels of biological order conceal an organization of the same order as that of perfectly individuated physical systems, for example those which engenders crystals, or the large metastable molecules of organic chemistry'. Hence, based on organization 'it is not so easy to put into a hierarchy life and matter'.

If there is a difference between physical and living individuations, it does not rest on organization, or 'some kind of static life, intermediate between inorganic reality and full-fledged functional life' (203, our translation), but on the polarities existing in matter itself which allows two different regimes of transformation: the physical regime, where information 'is not different from potential energy supports that actualize in the manifestations of organization'; and the regime of living beings, where individuation 'will be founded on the distinction between modulating structures and potential energy supports' (204, our translation). The physical must be related to transductive amplification, whereas the living is related to modulating amplification.

The same logic is used by Simondon to account for the difference between living and psychic-collective individuations. From vital dynamism, which posits in living beings the existence of what he calls intensity of information, as different from quantity or quality, a perceptive polarity unfolds which gives rise to the subject.

> To perceive, is … . to fight against a system's entropy, it is to organize, to preserve or to invent an organization (…) the perceptual activity is a mediation between quality and quantity; it is the intensity grasping and organization of intensities in the relation of world and subject. (Simondon 2005a, 243, our translation)

Referring to an intensity of information links the negentropic orientation of cybernetics with ontogenesis, giving place, according to Simondon, to allagmatics. If the difference between matter and life was in play before, in this framework, the difference between animals and humans enters into the game. This also becomes clear when we focus on the problem of technology within individuation theory. In the introduction to *Du mode d'existence …* , Simondon writes that 'the machine, work of organization, of information, is like life itself, with life, what opposes disorder' (1989, 15, our translation). Here, the ontological difference being questioned is between man and machine. What becomes decisive for Simondon is that cybernetics considered both as theory and as technology of artifacts with an explicit goal, 'frees men from the constraining closure of organization, rendering them capable of assessing such organization' (103, our translation).

At this point, there are two possible ways to understand organization. In one of them, organization is understood as finality, and this allows cybernetics to 'create organization by establishing teleology' (104, our translation). The equivalence between living beings and machines has the merit to remove the 'unconditional prestige' to the idea of finality, assuming that 'finality cannot be the deepest aspect of individual and social life' (104–105, our translation). This is coherent with the extension of the notion of organization to matter. The second way to understand organization, opposing the possibility of technological reductionism in the first, comes when Simondon remarks that cybernetics could only fulfill its promises based on a technological encyclopedism. According to Simondon, there are different periods of encyclopedism: the Renaissance lived an ethical encyclopedism, in which men believed 'in the "virtue" of techniques' but 'sciences were not so developed' (1989, 96, our translation). The Encyclopedia was driven by a technical encyclopedism, based on the dissemination of various techniques; and now, technological encyclopedism faces a social reality in which technical systems have turned against humans. Hereby, we come to the relation between information, which is essentially a social notion. One can even claim that while physical individuation is understood under a transductive scheme, and living individuation under a modulation scheme, that the

psychic-collective and transindividual, where technology is one of its key concepts, should be understood in terms of organization.

In order to act as a receiver of information, a system's component must have 'a high level of organization' (2010, 160, our translation). Simondon claims that organizing amplification is the 'real synthesis' of transductive and modulating amplification (171, our translation). What defines organization is that 'each successive decision accounts for the effect of previous ones' (170, our translation), since it changes its relation with time with respect to other modes of amplification: if transduction is an impulse toward the future, and modulation is a repetition of the past, organization 'corresponds to the stability of a complete present, a dilated moment, a stage which condenses and preserves a certain dimension of the past and certain duration of the future; it corresponds to a thickness of time' (174, our translation).

The first example of organization considered by Simondon is the integration of visual information in binocular perception as an example of organization. The incompatibility of retinal images 'becomes serialization, organization, accounting and totalizing, dimensional principle of a higher order' (170, our translation). Two other examples are the relation of the living organism with its milieu, through which, following Lamarck's evolution hypothesis, the organism incorporates 'under the form of new functions, of sequence of events that occurred previously depending on the milieu' (172, our translation) and the second, is the emergence of consciousness, whose activity consists in discovering ever more levels of organizing levels 'rendering the ancient elements of interiority and exteriority compatible in a larger dimensional system' (172, our translation).

Simondon insists in the refusal of an ontological division of spheres, between the living sphere, the social, and the artificial one. He suggests that life and consciousness are not different orders, and that the elemental aspects of life are already endowed with consciousness. With respect to the social, it is not exclusively human: 'molecules, elementary cells, can be related one to the other by some kind of social relation, implying control, modulation, reduction of activity' (172, our translation), even the notion of society 'extends to animal species' (173, our translation)[2].

In sum, the three modes of amplification 'are characteristic of three kinds of dialectical relations'. Simondon asks whether it is not a three-stage process: 'initially transductive, next modulating, finally organizing' (173, our translation).

Organization, I believe, needs to rest on the assumption that current technology has incorporated, besides technical elements (*tools*) and technical individuals (*machines*), technical *ensembles*: tools, bodies and machines in a new synergia that our time is still developing. This synergia depends on acknowledging the value of organization over the information processing systems. And in such synergia, the ontological differences among animals, humans and machines are dissolved in an extent that cybernetics, even with its focus on operations rather than structures, did not achieve.

Final words

Simondon's formulation of a theory of information, at the same time philosophical, scientific and technological, establishes the grounds for a better understanding of the links between information and organization. Nevertheless, this does not mean that Simondon has pronounced the last word regarding these issues, and that our task is limited to describing his philosophical system as a revealed truth. Confronting his theory with, for example, Turing's postulates and the different modes of understanding computation today, and with 'what information processing machines really do', shows that his program to reform some fundamental notions in science, technology and philosophy contains some very debatable preconcepts about the difference between the human and artificial realms. But some elements offered by Simondon himself help in overcoming these difficulties. Hereby, a better starting point to elaborate a unified theory of information and organization is realizable. A thorough understanding of information and organization necessarily needs to go through the hard road of comprehending of the complex and delightful theory of individuation that Simondon has bequeathed us.

Notes

1. > It is, essentially, the operation commanded by a free man and executed by a slave (…) The active character of the form, the passive character of the matter, comes from the conditions of transmission of the order that implies a social hierarchy (…) The distinction between form and matter, between body and soul, reflects a city which has citizens in opposition to slaves (Simondon 2005a, 51, our translation).

2. Besides Simondon's *Deux leçons sur l'animal et l'homme*, we can quote about this blurring of boundaries the following extract from ILFI (2005a, 165, note 6, our translation, our emphasis):

   > This means that there are not on the one hand only-living beings and on the other hand living and thinking beings: *animals probably just find themselves less frequently than humans in a psychic situation*. The human, having available more extended psychic possibilities, in particular due to the resources of symbolism, more frequently calls on psyche; it is the vital situation that is exceptional in the human, and thus humans feel more destitute in it. *But it is not a matter of a nature, an essence, serving to found an anthropology*; it is simply that a threshold is crossed. *Animals are better endowed for living than for thinking, human beings better for thinking than for living*. Both of them live and think, normally or exceptionally.

Disclosure statement

No potential conflict of interest was reported by the authors.

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