# Induction, Deduction and Transduction

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# Induction, Deduction and Transduction: On the Aesthetics and Logic of Digital Objects[1]

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**ABSTRACT**

The article questions the two dominant views on media aesthetics – one takes the empiricist stance, and the other pushes forwards a media-technological *a priori* – in order to posit a third view. This view is transcendental empiricism, which one can trace in the work of Gilbert Simondon and Gilles Deleuze. This article demonstrates this argument with the example of digital objects – the new form of industrial objects composed of data and metadata – and proposes to investigate their aesthetics by articulating three logical operators – induction, deduction and transduction – as correlations to the three views mentioned above.

**KEYWORDS**

Digital Objects; Induction; Deduction; Transduction; Gilbert Simondon

1 I would like to thank James Burton and Erich Hörl for their comments on this essay. An earlier version of this article was published in German in the *Zeitschrift für Medienwissenschaft,* Heft 8 (April 2013). All quotes from Simondon are translated by the author.

## Aesthetics

Each epoch is characterized by certain technical aesthetics. The use of different media of production and operation introduces various forms of experience that renew our perception of the world. Prosthetic organs, in the forms of tools, instruments and machines, remodel our behaviour, comportment and understanding. This is partially determined by a general tendency of technology, consisting in the materialisation of all sorts of relations by rendering the invisibles in *visible* and measurable forms. For example, writing puts thoughts and perceptions on paper; pulleys, wheels and chains concretize imaginary movements in mechanical terms; the steam engine instantiates flows of energy in the relations between water, fuels, pipes and gears; one could give similar examples for electricity, nuclear energy, etc. Media aesthetics and its potential are closely related to, and conditioned by, the logic of technologies, which is concretised by new materialities. By aesthetics and logic, I make allusion to Kant's *Critique of Pure Reason* (1996), in which he understands transcendental aesthetics as sensibility [*Sinnlichkeit*] (in terms of space and time) and transcendental logic as understanding, meaning the organisation of sense data to give rise to concepts.

Media aesthetics, understood in this sense, is an approach to understanding the transformation of aesthetics (sensibility) under technological development; while this question of aesthetics won't be futile without taking account of the logical part, since they necessarily form a cycle, as Kant (1996) shows in his three syntheses of time (apprehension in intuition; reproduction in imagination; recognition in a concept). The role of technics is not taken in Kant's analysis, as shown in the third volume of *Technics and Time* by Bernard Stiegler, where he showed that Kant ignored the exteriorised memory, which gives rise to a fourth synthesis of time (2011, 141); as well as the posthumous publication of Gilbert Simondon's *Imagination et Invention* (Simondon 2008), in which he extends Kant's synthesis and situates sense data, mental image, symbols and invention in the same cycle. In consequence, my interpretation of the fundamental question concerning aesthetics is *imagination*.

A certain interpretation of media aesthetics sees media as an artificial environment that is purely empirical, as Mark Hansen puts it, "without functioning as a transcendental condition" (Hansen 2006, 297). Hansen's view is understandable when one thinks of embodiment in which the role of the receiver is emphasized. The counter-argument would be that media aesthetics is always framed

within certain technological conditions, in the form of hardware, algorithms, database structures, etc., which already pose a certain set of *artificial conditions of possibility* for thinking and acting, or what Kittlerian German media studies calls "media technological a priori" (Winthrop-Young 2011). This view is evident when we emphasize the working conditions regulated by computers today. After the first industrial revolution, workers, as observed by Karl Marx, are no more than servants that operate mechanically with machines; the invention of the assembly line further intensifies the repetitive nature of the human bodily activity involved, in order to synchronize with the rhythm of machines; the turn from labour workers to intellectual workers demonstrates the new relation between technical apparatus and intellectual workers, and produces other kinds of gesture (Berardi 2009).

These two different views (*a posteriori* and *a priori*) all find their reasons. On the one hand, categories, rules, hierarchies are prior to any operation, and are therefore embedded in order to organize it and avoid errors. On the other hand, computation has been recognized as an empiricism, since inputs, algorithms and hence outputs are largely based on empirical experience; moreover in the recent development of computation, a bottom up approach is often used, for example to derive rules and patterns based on induction (if we think of big data), instead of a top-down deductive action. The task of this article is to reflect on the logic and aesthetics of digital objects, departing from the opposition between the *a posteriori* and the *a priori*. However, this task is ambitious and it won't be easily achieved without ambiguities. The method that this article employs is Simondonian; that is to say, to resolve the tension between two terms by the invention of a third term.

Following the opposition between the transcendental and empirical understandings of media, this article proposes to re-elaborate the question by looking at three logical operators: induction, deduction and transduction. The first two are known as methods, especially in mathematics and other scientific disciplines; they are also central to: firstly, the production of digital objects, that is to say their working principles, and, secondly, the interaction between digital objects created according to different ontologies (in its technical sense rather than philosophical sense in the genealogies of Martin Heidegger or Étienne Gilson). Induction and Deduction are *analogical* to human experiences as explained in Hume's empiricism and Kant's transcendentalism, respectively. While transduction is an effect and genesis rather than an inference understood in classical logic, it allows us to go a step further, to the question of transformations, ruptures, etc. The interpretations of these terms are respectively based on what I have identified as transcendental empiricism

(transduction) in the thought of Gilbert Simondon (Sauvagnargues 2010)[2]. I hope by the end of my treatment of the third term, it may provide us with a new lens, or at least some useful remarks to look again at the question of digital aesthetics. The question first to be addressed is what exactly is a digital object? And how is it related to media aesthetics, especially in terms of the dispute between the transcendental and empirical views as discussed above.

## Digital Objects

Here is the first definition: digital objects are materialized forms of both *sensitive* and *noetic* data in structural forms[3]. When we look at the term "data" we hardly recognize that its Latin root *datum* originally means "[a thing] given"; the French word for data, *donnée*, retains this meaning. If data are the things given, what gives them? Aside from a theological reading of the term in relation to the origin of things, we should recognize that since 1946 the word "data" has had an additional meaning: "transmittable and storable computer information"[4]. This second sense of "data" suggests the need for a reconsideration of the philosophy of objects, since it can no longer be taken to refer purely to sense and noetic data, or to a mode of being together of being and thinking, as Heidegger would suggest; instead, one has to recognize its translation into material form, and how this materiality constitutes a new kind of "givenness". The significance of the new technique of data processing we now call the digital is not only that with computers we can process large amounts of data but also that by operating with data the system can establish connections and form a data network that extends from platform to platform, database to database. *The digital remains invisible without data, or traces of data*.

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2 I borrowed the term transcendental empiricism from Deleuze; I believe Deleuze was inspired heavily by Simondon in his use of this notion, but there is no space to go into a detailed comparison in this article. I also take transduction here as a logical operator, and hence I would like to distinguish myself from the interpretation of Adrian McKenzie, who takes it from the perspective of process philosophy and embodiment in his book *Tranductions – Bodies and Machines at Speed* (London: Continuum, 2002)

3 This refers to Aristotle's categorisation of souls: vegetative, sensitive and noetic.

4 Online Etymology Dictionary, http://www.etymonline.com/

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What I mean more specifically by objects is conceptualized or structural data; for example, a chair has 4 legs, is made of wood, and so on; such predications constitute the identity of the object[5]. The formal description of objects is normally understood as metadata scheme or an ontology (let's put aside here the polemics of this word first); it specifies the properties and relations of the objects, and hence can be used to structuralise metadata. When this data is digitized as a unified object, such as those in object-oriented programming or in the semantic web, we will have digital objects. To give a simple example, a Facebook image or a YouTube video consists of large amounts of metadata, that defines the properties, functions, permissions of these objects, that in turn defines the object's relations to other objects, as well as to the backend program and to the users. The development of digital objects follows a technical lineage of industrial standardisation of mark-up languages, for example from SGML, to HTML, to XML, XHTML, to Web Ontologies (Hui 2012). The movement towards formalizing data within an objective (in the dual sense of being non-subjective and referring to objects) framework is called the "semantic web", a term proposed by the inventor of the web, Tim Berners-Lee[6]. Indeed, digital objects are the new type of industrial objects of our time, and the fact that this goes far beyond the question of computation itself, is explained by Berners-Lee himself in recounting his vision:

> "I have a dream for the Web . . . and it has two parts.
>
> In the first part, the Web becomes a much more powerful means for collaboration between people. I have always imagined the information space as something to which

5 This involves the developments of Artificial Intelligence from the 60s to the 80s, in which we find a debate on how we perceive objects. The earlier AI scientists believed that we could only know an object through representation, which also means through ontologies. Hubert Dreyfus criticized this approach for being too Cartesian, and he proposed taking instead a Heideggerian approach to embodiment, which stimulated many new strands of AI research from the late 70s to 80s. But the ontologies-based approach is still popularly employed, and today it returns as an important topic in the development of the semantic web. Please refer to H. Dreyfus's (1992) *What Computers Still Can't Do: A Critique of Artificial Reason*

6 T. Berners-Lee (2000) *Weaving the Web: the Past, Present and Future of the World Wide Web by its inventor*

> everyone has immediate and intuitive access, and not just to browse, but to create. [...] Furthermore, the dream of people-to-people communication through shared knowledge must be possible for groups of all sizes, interacting electronically with as much ease as they do now in person.
>
> In the second part of the dream, collaborations extend to computers. Machines become capable of analyzing all the data on the Web - the content, links, and transactions between people and computers. [...] The intelligent "agents" people have touted for ages will finally materialize. This machine-understandable Web will come about through the implementation of a series of technical advancements and social agreements that are now beginning...” (Berners-Lee 2000, 157)

Here is the role of digital objects in terms of data and information processing: they allow the intelligent “agents” to automatically analyse and create relations for us. One aspect that deserves our attention and that we will take up again later is the effort to search for a common ground between machines and humans, which in this case, Tim Berners-Lee calls semantics. My interpretation is that what matters in this view is not really the “semantic” dimension, but a common conceptualization of “object-hood” that can be shared by computers and humans. This conceptualisation is inherited from a historical philosophical tradition. We can probably call this the “image of an object”, or, technically speaking, “ontology”. However, whether this conceptualization really comes within the category of semantics is not the most important issue here; rather, this is a point of departure from which we can generalize it as technical reason, which traverses different domains and different disciplines.

## Induction

When employing induction, one starts from a bunch of facts, and induces a rule that governs all these facts (from facts to truth); deduction starts from a general rule, and deduces facts that accord with this rule (from truth to facts). Induction is empirical in that it assumes that rules derive from facts but not the other way round. The induction of a certain idea of objects relies heavily on the notion of relations. Digital objects, so to speak, are a bunch of *indexed* relations. They may also be considered the realization of a “relational aesthetics” in material terms. I use the term “relations” to

contrast against "substance"[7]. Here I allow myself to circumscribe the whole Aristotelian tradition and discussion of the medieval philosophy on the Trinitarian question, and go directly to British empiricism, especially David Hume. What we can take from Hume is that substances cannot be demonstrated – we can only think through relations. Hume's argument is fairly simple but at the same time ingenious: to demonstrate substance, we need to have an idea or at least an impression of it, based on our empirical experiences; if we don't have such an idea or impression, then we are not able to rely too heavily on the concept of substance. Hume instead proposes to understand objects in terms of relations. Hume's theory of relations has not received the attention it deserves. It is widely known that Hume proposed a concept of associationism which is based on three types of *natural relations*: contiguity, resemblance and causality. Hume, in fact, proposed seven types of *philosophical relations*, namely: *Resemblance, Identity, Space and Time, Quantity, Quality, Contrariety, Causality* (Hume 2008, 23). Deleuze (2001) in *Empiricism and Subjectivity*, a treaty dedicated to Hume, declares that beings are relational.

Relations serve as the foundation of two processes, firstly perception, and secondly the formation of ideas. For example, the perception of an apple doesn't come from without, it comes through comparison and induction in experience. By exposing myself to an apple, the sense data, such as <color>green</color><shape>round</shape> come into my perception and are unified by the relation of contiguity, since they fall together temporally and spatially. This view of relations is directly reflected in computation, especially considering the associations between digital objects that establish relations among themselves. For example, the resemblance between the title of a book <title>*On the Existence of Digital Objects*</title> and another book <title>*On the Mode of Existence of Technical Objects*</title> makes us aware of resemblances between them. These relations are criteria for information retrieval. We can also recognize that in data visualisation, the usual approach is to identify those relations that can produce the most interesting visual effects. These "relational aesthetics" presuppose that human understanding is based on the organisation of ideas through relations (Rosch et al 1992, 52)[8]. Hume's radical empiricism reflects the possibility of connections among data, and how these connections cause the world that we are in to appear. Yet, this notion of pure empiricism encountered its own shortcomings when Hume posed the question of

7 I refer to Aristotle's theory of substance and accidents: according to Aristotle, relation is only a type of predicate. Hume overturns the position of relations, as will be explained below.

8 The linguist Ray Jackendoff proposes the reunification of these two minds - on the one hand the computational mind, which involves unconscious symbolic computation, and, on the other, the phenomenological mind, which is characterized by conscious experience.

the necessity of causality, and also the eidetic nature of ideas or concepts. Here we come to the spirit of induction: repetition and resemblance. Considering a game of billiards, Hume asked, are there causal rules that govern the movements of the balls? His answer is no, the causal laws are in fact conditioned by habitual observations.

> The first time a man saw the communication of motion by impulse, as by the shock of two billiard balls, he could not pronounce that the one event was connected: but only that it was conjoined with the other. After he has observed several instances of this nature, he then pronounces them to be connected. What alternation has happened to give rise to this new idea of connexion? Nothing but that he now feels these events to be connected in his imagination, and can readily foretell the existence of one from the appearance of the other (Enquiry concerning the Human Understanding, E75f.) (Streminger 1980, 97)

The habits are indicated by click rates, by frequencies of contact, etc. The Humean aesthetic is significant when we consider the operation of data, and makes sense of the simple interactions between the system and the users. For example, why is video B recommended after video A finishes? The relevance of B to A is determined by the calculation of relations between objects themselves according to their habits. In this sense, we can also talk about *inter-objectivity* instead of *inter-subjectivity*. There is little difference between this example and that of online marketing, with its use of advertisements based either on personalisation or crowd sourcing: they are based on the same principles. At the heart of Hume's associationism is the power of the imagination; it is also by imagination that Hume moves away from the mechanical understanding of the mind to a more metaphysical interpretation of thinking and being.

Such a power of imagination remains an unachievable project for computers, since instructions are not imagination. The lack of imagination is compensated by the schemes that render the connections necessary. We may recall that the task of Kant's *Critique of Pure Reason* is to answer the question: How is *synthetic a priori* possible? The categories are the a priori criteria which give rise to the “metaphysical deduction of concepts” (Deleuze 2004, 20). The subject becomes the legislator of nature in the sense that it is the transcendental faculties that give rise to the unified perception and identity of objects. This is why I mentioned at the beginning that an “artificial transcendental condition” is required to regulate the operation of objects in perception as well as in

computation.

## Deduction

Deduction is always artificial. The transcendental deduction was the deduction performed by Kant, developed as a rule to be followed in order to understand the foundation of knowledge. Kant's transcendental deduction hence attempts, in response to Hume, to solve the problem of the identity of objects of experience – since according to Hume, the identity of an object cannot be guaranteed. From this perspective, we can understand why in the 1787 edition of the *Critique of Pure Reason*, Kant deliberately deleted the part on the transcendental imagination, which plays a decisive role in the transcendental apprehension in the 1781 edition (Heidegger 1990). This is because the transcendental imagination cannot completely deflect the Humean scepticism. It is only in the *Critique of the Power of Judgement* that Kant revokes the view that the imagination is the force that resolves the conflicts between the faculties of cognition and judgment. He prefers the concept of schema over the imagination in the first Critique. Indeed, Kant is much more machinic than Hume in this sense. Schema is thus a standard that assures identity across several instances of an object – we can even consider it as a standard, in the sense that is later used for mass production in industry. Schemas are also used widely in the design of digital objects: known as ontologies, they are the structures that produce, reproduce, and model objects. Schemas also become the base of the production of relations, and allow them to be more explicit (going beyond the possibility of binary comparison, e.g. same or different). Deduction here means that by deducing the manifold to a limited number of properties, one can reproduce objects that have more or less the same identity, even though they exist as different individuals.

In the history of computing, enormous efforts have been devoted to the invariable terms that stand for objects. These culminate specifically in the development of knowledge representation and, today, the semantic web. In the 1980s, Knowledge Representation (KR) took its proper form, as the universalisation of objects and objectified sensitive and noetic data. Tom Gruber, an ontologist and computer scientist who later invented Siri for iPhone, proposed one of the most well-known definitions of ontologies: the specification of conceptualization (Gruber 2004)[9]. This proposes that by conceptualizing objects, one can deduce a limited number of the essential properties which give

9 T. Gruber, "Every Ontology Is a Treaty." SIGSEMIS Bulletin 1, no. 3 (2004)

a recognizable identity to those objects. In *Object-Oriented Programming*, the objects possess similar properties, the only difference being that there is a move beyond the *eidos* and the *morphe* to the level of functions, a distinction which is blurred during the development of digital objects. Ontologies, whether in the context of formal ontology, or web ontologies (not to mention industrial standards such as Dublin Core, FOAF, or some user-generated ontologies), are more or less all based on the same principle.

Returning to Kant and Hume here is intended to offer a way of reposing the question of aesthetics concerning the experience and modes of existence of objects, and the philosophical debates that remain neglected within the dogmatic approach of computation, and possibly also philosophy of media and technologies. Hume's associationism and Kant's schematism, if translated in this way, give us two different *modes* of the operation of digital objects and two *understandings* of operations on the side of computation: the re-assemblage of data according to the sedimentation of experiences, that is to say *memories*; and the organization of data according to pre-defined schemas, that is to say *anticipations*, in a certain sense. According to Hume, the colour green comes from the empirical experience of the same colour that is finally named as being green. According to schemas, the *a priori* already defines the transcendental structure of the condition of possibility of experience. In this regard, schemas provide short-cuts for cognitions. Yet we have to recognize that associationism and schematism don't necessarily oppose each other here, but serve as the foundation of a transcendental empiricism to be explored later.

Imagination remains obscure in the above exploration of induction and deduction of digital objects. The common ground of “images of objects” or “semantics” shared between humans and machines demands that we *re-negotiate* the relation between these artificial conditions of possibility and the empirical experiences, in order to update a unified theory of media aesthetics. Some philosophers and neuroscientists have written extensively on the neurological connection between technical apparatus and the mind/brain: notable concepts include Bernard Stiegler's tertiary retention, where he suggests that technologies exist as an artificial memory that directly conditions the primary retention (impression) and secondary retention (memory) (Stiegler 2009); Andy Clark and David Chalmers’ extended mind, in which they proposes that the mind thinks beyond the skull, the technical apparatus becoming an internalized function of the brain (Clark & Chalmers 1998); as well as John Haugeland's embedded mind (Haugeland, 1993) and Fred Dretske's externalism (Dretske 2004). It is true that the phenomenological mind and the computational mind are mediated

by the interfaces and algorithms that bridge the multiple types of relations, both discursive relations and existential relations (memories, anticipations, projections). However, it appears to me that some of these theories rarely tackle the technical aspect concretely, as Simondon demonstrated in *Du Mode d'Existence des objets techniques*; instead the question of technicity is often taken as that of a general abstract entity.

## Transduction

Deduction and induction show us two different ways of understanding experience and two perspectives on the operation of digital objects. Induction is more operational than deduction, since deduction is more rigid, but surer. However, these two models, which one can call empirical and transcendental, cannot fully account for the operation of digital objects; it is also here that we can observe the technicity within philosophy, properly speaking. Media aesthetics, understood as purely empirical, as discussed at the beginning of this essay, ignores not only the transcendental question, but also the fact that empirical experience, including perception, movement etc., cannot be detached from a formalized technical condition. While transcendental thinking is always too rigid, it cannot account for anything that exceeds the framework set by itself, since the excess exists only when there is a limit. So we need to find another entry-point that will allow us to integrate a more comprehensive understanding of media aesthetics, which, on the one hand, grasps the transcendental without losing the empirical; and, on the other, firmly grounds the psycho-social affects produced by media technologies in their technical reality. This is the reason that we need a third term: transduction.

We can speak here of transduction as *effects* of induction and deduction (if we are allowed to say so, another condition of possibility). I take the term transduction from Simondon's theory of individuation. Transduction comes from the prefix trans- (across) and ducere (to lead), meaning "lead along or across, transfer"[10]. Transduction signifies a process or an action that leads to the transformation across different domains. In fact, already in the philosophy of Descartes the "pineal gland" serves as a transductor. For Descartes, all the stimuli are accumulated in the pineal gland before they are submitted to the soul. He thought the pineal gland has a special position because it is the only part of the body which is not double, e.g. we have two eyes, two ears, etc. (Lokhorst 2014). The pineal gland is the transductor that connects the soul and the body by translating or transferring

10 http://www.etymonline.com/index.php?term=traduce

the stimuli into the language of the soul. In engineering terms, a transducer is a device "for converting energy from one form to another for the purpose of measurement of a physical quantity or for information transfer"[11], as in, for example the transducer which converts the cathode ray into images.

Simondon keeps the technical meaning of transduction as a means of communication and transmission. Furthermore, he identifies transduction as the third way that juxtaposes induction and deduction, and provides a type of thinking that doesn't move uni-directionally from inside to outside, outside to inside, individual to collective, collective to individuals, but rather presents itself as the *empirical* process of the *transformation of forms and structures*. It will be also useful to think of transducer and transduction together, that is to say, to think of transducer in the process of individuation. Simondon often used, as a means of illustration, the process of crystallization. When a supersaturated solution is given some heat energy, it starts to crystallize; when ions are structured as germs, they release energy which proportionate to other parts and trigger more crystallizations. Here we see two phenomena. Firstly, the process of amplification, meaning the transmission of germs is speeded up because of the energy released during crystallisation. Secondly, there are tensions created between ions and crystallisation, which become the means of resolving tensions in order to achieve a metastable status:

> A physical, biological, mental, social operation, by which an activity propagates closer and closer to the interiority of a domain, founding this propagation on a structuration of domain operated from place to place: every region of the constituted structure serves the following region of the principle of constitution, so that a modification can extend progressively at the same time as the structuring of this operation. A crystal, which from a very small germ, grows and extends to all directions in its water-mother provides the simplest image of transductive operation; every molecular layer already constituted serves as the structuring base of the layer in process of formation; the result is an amplifying reticular structure. Transductive operation is an individuation in progress (Simondon 2005, 32-33)

Transduction demands a system that is already energetic and ready to undergo a structural transformation. Such a system is neither fully open nor closed, since it depends on the

11 http://www.its.bldrdoc.gov/fs-1037/dir-037/_5539.htm

compatibilities between the incoming elements and the system itself. How can we think of a transformation of forms regarding digital objects, while these schemes are already pre-configured and structured, and any variation leads to incomparability between the communication of different apparatuses and machines? To think of this, we must shift between different orders of granularity, which brings us back to the above-mentioned "images of objects". The sensitive and noetic data, when they are formalized, become "images" of computers, in the sense of an image for re-cognition rather than observation. The standardised digital objects serve as transducers in the ensembles of machines connected by computer networks, and also as transducers that intervene directly in the everyday acquisition of information and knowledge production. Ontologies are like what Simondon would call portable and transferable technical elements, which integrate users into their functioning; that is also to say, to form a technical individual that stretches beyond automation (Simondon 2012, 75-81).

Considering a human-computer system apart from the emotion and affect generated within the interaction process, there exists a level of thinking that is common to both humans and machines in terms of symbols and images. The relationship between symbols and images is complicated: for Simondon, a symbol is a type of image that participates actively in circulation with immediate images (immediate impressions), eidetic images (e.g. Proust's memory of the taste of the madeleine soaked in the warm tea)[12]. Symbols and images, in contrast to concepts, allow comparison; that is to say, they are concretized and materialized at a level that makes certain features comparable. Structural data are images for machines, like pictorial memories for humans, since they are concepts in material forms. This creates a circuit, or even a system of communication, which is no longer purely semantic, linguistic or visual, yet still relies heavily on symbolisations. On the other hand, Simondon also proposed to move from the operational perspective of technical objects to object-images, meaning images attached to objects that gradually become symbols. One of the examples Simondon used is the watch and Switzerland; these technical objects finally become symbols of the nation. It is on this level that Simondon explores the psycho-physiological effects of object-images (Gutchet 2010, 156).

Although such analyses involve very detailed studies of different types of technologies and schemas concerning digital objects, we can still summarise the amplification effects in two general points,

12 See G. Simondon, *Imagination et Invention,* Première partie, Contenu Moteur des images ; Image avant l'expérience des objets

corresponding to the inter-objective and inter-subjective operations. Firstly, there is the production of relations enabled by ontologies and standards that allow these ontologies to be compared on the same plane. The production of relations can be amplified in proportion to the amount of structured data, and concretized in terms of networks of materialized and calculable relations. Simondon's transduction assigns a minimum transcendental nature to germs in the process of crystallisation; these germs are not transcendental conditions that form a framework by which data are subsumed as concepts, as Kant describes in the *Critique of Pure Reason*, but rather essential elements that don't necessarily constitute frameworks[13]. In this sense, it would not be justified to oppose taxonomy (ontologies, top-down indexation) against folksonomy (tagging, bottom-up indexation), but rather to see them as *sources of relations* which enable the formation of networks *empirically*. This view of transcendental empiricism doesn't take the relation between the transcendental and the empirical as a field constituted between two poles, but considers the transcendental and the empirical on the same *plane* of tensions. Forming relations entails the recognition of tensions; these tensions are formed due to the comparabilities (and also because of incomparabilities, i.e. differences) among systems and data formats, otherwise they remain indifferent to each other. For example, without shared vocabularies and standard formats, an extra process of translation has to be added to establish a compatible milieu. The crystals are formed because of the incompatibility of various elements in the solution, and the tension created by the prorogation of energies: they have to cope with this incoming force by structuring themselves in certain orders. The structuring processes are operated in the case of digital objects by the "mechanical imagination", which is to say the association of relations and the induction of habits. As Simondon points out: "the symbol is only a pseudo-object, loaded with all the potential energy of a metastable system, ready to initiate a structural change" (Simondon 2008, 135).

The second amplification effect comes in terms of the formation of networks of users through the mediation of digital objects. We can observe here the connection between the psycho-social and the technical. It is true that we can observe certain similar effects concerning technical objects, such as tools and instruments, but digital objects exhibit a kind of vitality that is supported by a certain degree of openness in the system or the milieu that they situate. For example, the incorporation of real-time data in the synthesis of digital objects. We have to treat this point somewhat carefully, since it is evident that social networks serve such purposes, but I am shifting the focus from social interactions to a psycho-social and cognitive level. Digital objects constitute the foundation of the

13 When I say framework, I refer to the action of subsumption, like moulding.

social milieu, and at the same time, they also become part of the thinking of the "I" and the "we".

I take this from the functionalism of Andy Clark, and Simondon's psychosomatic understanding of technical objects. According to Clark and his collaborator David Chalmers (1998), these instruments become part of thinking, or as discussed above, the necessary elements which are not frameworks. For example, a laptop which stores the memory of an Alzheimer's patient performs a supporting function for thinking. It doesn't mean the patient cannot think, but his thinking goes beyond the skull with this "artificial memory"; in doing this, he is identifying himself with the technical object. His structure or form of thinking is transformed, since now it needs the other, without totally depending on it. Simondon's proposition supplements and complicates Clark's by illustrating the relation between a child and his toy. Children often identify obscure (to adults) objects as toys, for example a yellow hen, some stones, etc. Simondon doesn't want to understand these toys in psychoanalytical terms: e.g. the Me, but in terms of the coupling of the I and the object:

> This doesn't signify—outside of the psychoanalytical interpretation—that object is the symbol of Me as well as representation of Me, image of Me. It is rather my respondent and associate, without being confused with the Me (except in certain extreme cases where the belongings become like an envelope, an epidermis of Me); the object is the other, in relation to Me, not the same, but another in a coupling with Me, his best friend (Simondon 2008, 99).

For Simondon, technical objects have a strong sense of functionality, which resonates with the thesis of external cognition. At the same time, for Simondon, it is not only an "object" but also a "friend" that demands trust and intimacy. Where does this friendship come from without a milieu, that is to say a milieu of digital objects? We can consider an object on Facebook, for example the profile, or even a profile picture, its interaction with other objects within the milieu that presents this "friend" to me, while it is also subsumed to control, since it is also computable data. The appearance of this "friend" is also based on the number of clicks, relations to other friends in the network, habits, etc. (which are purely machinic calculations); we have described in the section *Induction* above how they are empirically constituted in this manner.

The invention and concretisation of digital objects create a new coupling system that demands a

new questioning of aesthetics that must also take account of its technical condition. The question that this article wants to address is how can transduction be thought *through* induction and deduction, instead of separating it as a totally different entity? Empiricism and transcendentalism find their reasons in transduction – a new metaphysical understanding of individuals and objects. The transcendental nature of pure reason enters a circuit with the "artificial transcendental faculties" of computers which, though defined empirically, look for invariable terms or the transcendental nature of things. This circuit also extends to a Humean empiricism based on the production and association of relations created by the sensitive and noetic data in material forms. In brief, vertically, the question of "image" moves from the human perception down to a "machine image"; horizontally, imagination extends from the subjective imagination to one which is not thinkable without machines or data and algorithms.

## Conclusion

There are still two questions to be followed immediately, which however are out of the scope of this short article, but should be mentioned. One concerns organisation, since transductive amplification for Simondon is only on the lower level, above which there are modulative amplification, and lastly organising amplification (*amplification organisante*) (Simondon 2010, 159-176 ). The two other amplifications employ mechanisms which allow them to effectively control the transductive process, and these concepts of amplification are very relevant for further analysis in what the philosopher Jean-Hugues Barthélémy (2014, 141) calls the "universal cybernetics" of Simondon. The other is the question of information which is also related to the first question, and it remains a question to be answered, especially concerning the relation between the above materialist analysis and Simondon's notion of information as *disparation*, that I have analysed elsewhere[14].

To conclude, this article investigates media aesthetics concerning the emergence of digital objects, the rapid growth of data, data visualization, etc. This article wants to understand operations and processes within machines, and emphasizes a consideration both of the technical condition and the transformation happening beyond this condition, that serves as a starting-point for moving into the sphere of the psycho-social and political aspects of objects: acquisition of habits, rules driven operations, etc. The discussion of deduction and induction articulates two modes of operation of

14 I have tried to further discuss these questions in 'Simondon et la question de l'information', *Cahiers Simondon* 6 (Paris: L'Harmattan, 2015)

digital objects: though framing them with the philosophy of Hume and Kant may exhibit a certain kind of rigidity, the intention is to reconnect philosophical inquiries with the current search for a digital aesthetics, and in order to develop a historical lineage of philosophical thinking and the technicity associated with it.

In fact, I believe it is fruitful to go back to fundamental questions that may help us to escape the ecstasies produced by industrial aesthetics. Through the path followed here, we can identify a common ground between machine and human that is shared by both philosophical and technological lines of thinking, which is also why this article starts and ends with images and imagination. This common ground also demands a new interpretation other than induction and deduction for both technological development and humanities studies. Deduction and induction become terms that serve transduction, and make the human-computer interaction into a focus for concrete analysis. Transcendental empiricism *qua* transduction is the third term that resolves the tension between the transcendental view, which is against the bottom-up approach, and the empirical view, which is against the top-down approach, since it admits that certain elements are necessary for certain events without necessarily subsuming within a framework or structure in its totality. In this article I tried to propose that this may serve as a new framework/method for analysing media aesthetics. The neuro-turn and the computational turn in cultural analysis impose upon us a new challenge to return to philosophical questions concerning the mind and spirit, which is becoming dominant in our technical reality.

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