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'The whole is always smaller than its parts' – a digital test of Gabriel Tardes' monads[1]

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Abstract

In this paper we argue that the new availability of digital data sets allows one to revisit Gabriel Tarde's (1843–1904) social theory that entirely dispensed with using notions such as individual or society. Our argument is that when it was impossible, cumbersome or simply slow to assemble and to navigate through the masses of information on particular items, it made sense to treat data about social connections by defining two levels: one for the element, the other for the aggregates. But once we have the experience of following individuals through their connections (which is often the case with profiles) it might be more rewarding to begin navigating datasets without making the distinction between the level of individual component and that of aggregated structure. It becomes possible to give some credibility to Tarde's strange notion of 'monads'. We claim that it is just this sort of navigational practice that is now made possible by digitally available databases and that such a practice could modify social theory if we could visualize this new type of exploration in a coherent way.

Keywords: Social theory; Gabriel Tarde; actor-network theory; digital methods; data visualization

Introduction

It is generally accepted in the various sciences dealing with complex collective behaviour that there exist some fundamental differences between the individual and the aggregate levels (Knorr and Cicourel 1981; Calhoun et al. 2007). This is why it seems common sense to state that there should exist *two levels* of analysis: the micro level that focuses on individuals; the macro level that focuses on the aggregates. The consequence of such a distinction is that almost

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all the questions raised by social theory have been framed as the search for the *right pathway* that leads from one level to the other: should the inquiry begin from the micro or from the macro level? Is the macro a mere aggregate or a *sui generis*? How do some macro features end up emerging out of the interactions going on at the micro level (Boudon 1981)? Is it possible to 'reconcile' the two levels by another more encompassing theory (Bourdieu 1972; Giddens 1984)? Is it possible to imagine an intermediary level, a 'meso' one? And so on. This framing of questions is not limited to social theories dealing with humans, but has a bearing on all collections of non-humans living organisms (flocks of birds and swarms of social insects in particular) (Axelrod 1984; Moussaïd et al. 2009) as well as on the very notion of how an organism comes to be organized (for instance, how do individual cells relate to the whole body?) (Dawkins 1982)? Those same questions have been extended to a wide range of phenomena such as mental processes (Minsky 1988) or artificial entities living *in silico* (for instance, multi-agents models) (Epstein and Axtell 1996).

Although this division in levels has had an enormous role in shaping many research programmes in the natural and social sciences, it has also obfuscated the central phenomenon those sciences wished to account for: how to follow *stronger, wider and longer lasting associations*. By presupposing that there exist two levels, they might have solved too quickly the very questions they should have left open to inquiry: What is an element? What is an aggregate? Is there really a difference between the two? What is meant by a collective entity lasting in time?

In this article, we wish to consider how *digital traces* left by actors inside newly available databases might modify the very position of those classical questions of social order. Our aim is to test an alternative social theory developed by Gabriel Tarde (1843–1904) in the early days of sociology but which never had any chance to be developed because of the lack of empirical tools adjusted to it (Tarde 1903; Clark and Tarde 2011 [1969]; Milet 1970; Candea 2010). Instead of starting by saying that the really important question is 'to find out how individual decisions relate to collective actions', we want to do exactly what Tarde suggested and *refrain* from asking this question so as to lessen its import and to turn our attention to a different topic: is there a way to define what is a longer lasting social order *without* making the assumption that there exist two levels (Latour 2005)? To dramatize the contrast, we will claim that there is *more complexity in the elements than in the aggregates*, or stated a bit more provocatively that 'The whole is always *smaller* than its parts'. We call this hypothesis '*the one level standpoint*' (1-LS) in contrast with the '*two level standpoint*' (2-LS).

Such a hypothesis has a chance to fly only if it makes an empirical difference in the treatment of data. This is why we will attempt to demonstrate two points:

a) some of the *new digital techniques* and in particular a few of the tools offered by network analysis may allow the tracing and visualization of the social phenomenon in a way that makes the 1-LS slightly more commonsensical than the 2-LS alternative;

b) it might now be possible to account for longer lasting features of social order by learning to navigate through overlapping 'monads' instead of alternating between the two levels of individual and aggregate. (Note that in what follows, the adjective 'social' should not be limited to human agents but extended to all entities treated severally).

To go some way toward proving our points, we will proceed in the following way: we will first make use of the notion of *profile* to give the general flavour of our argument (section 1); then, we will explain how our approach is different from the idea of structures emerging out of atomistic agents in interaction (section 2) and then how the notion of structure should be replaced by the circulation of differently conceived wholes (section 3). The remaining sections offer visual descriptions of 'wholes' that are much smaller than their parts (section 4) and suggest another type of navigation through data sets than the one associated with the idea of modelling (section 5).

1. How digitally available profiles modify the element/aggregate relations

The gist of our argument may be offered by considering how *profiles* now available on so many digital platforms are quickly modifying the very definition of what *individuals* are – and, correlatively, how we should handle aggregates. Although this reduction of the social connections to html pages linked to other html pages may sound too drastic, it is this experience of clicking our way through platforms such as Flickr™, Academia.edu™ or MySpace™, of surfing from document to document, encountering people and exploring communities without ever changing level that we wish to use as an occasion to rethink social theory. Of course, there exist many other platforms, but in this article we will draw heavily on Web 2.0 to exemplify our arguments because it has turned 1-LS navigation into a mainstream experience which might be captured in a sentence: the more you wish to pinpoint an *actor*, the more you have to deploy its *actor-network*.

Let's take a simple example. We all have had the experience of preparing a meeting by searching on the web the name of the person we are soon to meet. If for instance we look on the web for the curriculum vitae of a scholar we have never heard of before, we will stumble on a list of items that are at first vague. Let's say that we have been just told that 'Hervé C.' is now 'professor of economics at Paris School of Management'. At the start of the search it is nothing more than a proper name. Then, we learn that he has a 'PhD from Penn University', 'has written on voting patterns among corporate stake holders', 'has demonstrated a theorem on the irrationality of aggregation', etc.

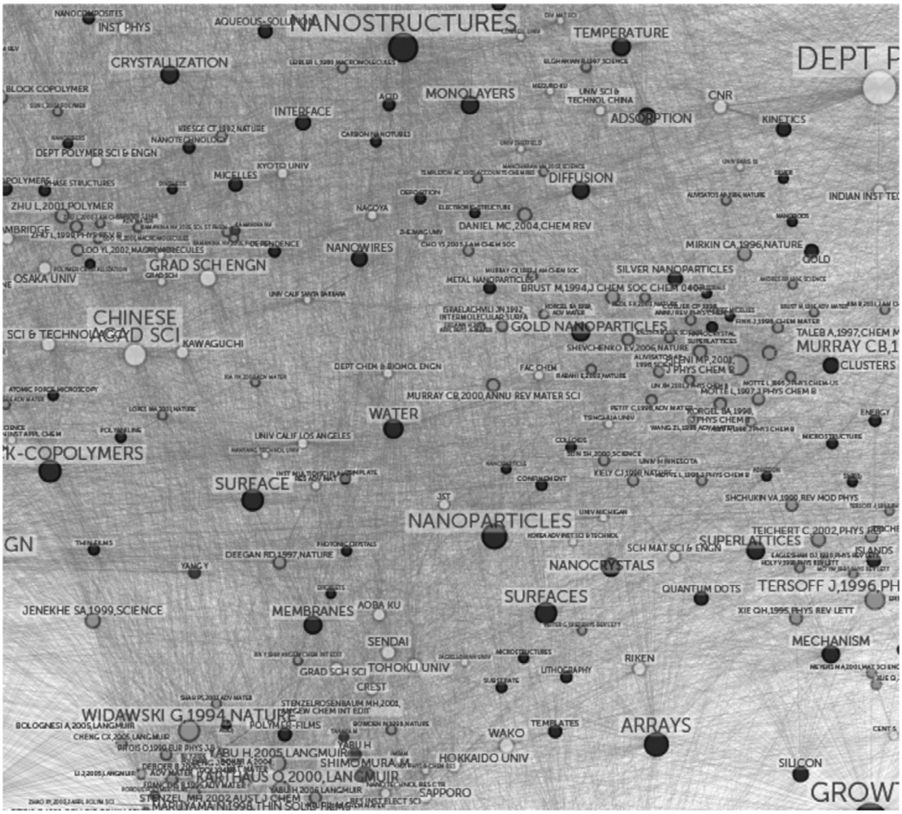
If we go on through the list of attributes, the definition *will expand until paradoxically it will narrow down* to a more and more particular instance. Very quickly, just as in the kid game of Q and A, we will zero in on one name and one name only, for the unique solution: 'Hervé C.'. Who is *this* actor? Answer: *this* network. What was at first a meaningless string of words with no content, a mere dot, now possesses a content, an interior, that is, a network summarized by one now fully specified proper name. The set of attributes – the network – may now be grasped as an *envelope* – the actor – that encapsulates its content in one shorthand notation.

In such a now common exploration, an entity is entirely defined by the open-ended lists in the databases. Using the terminology of actor-network-theory (ANT), an actor is defined by its network (Law and Hassard 1999). This network is not a second level *added* to that of the individual, but exactly the *same level* differently deployed. In going from the actor to its network, we remain safely inside the 1-LS (Law 2004).

The main point is that this definition is entirely *reversible*: a network is fully defined by its actors. If we now wish to go from this particular professor to some of his attributes, we might not be forced to change levels: the paradigm of 'stakeholders voting' will be defined by *another* list, this time the list of 'all' those scholars who write in it, and of 'all' the articles published that used those key words – something that bibliometry and scientometrics allow doing with a few more clicks (see Figure I and section 4 for examples). The same would be true if we wished to know what is this strange university called 'Paris School of Management': its profile will be given in part by the list of its academics. So there is no real difference in searching the identity of a person, a place, an institution, an event and so on. In all cases, the empirical and cognitive operation is the same. By circulating in such a way from the actor to the network and back, we are not changing levels but simply *stopping momentarily* at a point, the actor, before *moving on* to the attributes that define them. It is because there is no jump to another level that ANT defines as 'flat' the connections thus designed by its method of circulation through data sets (Callon and Latour 1981; Latour 2005).

This new experience of moving easily through profiles already makes clear that what is meant by 2-LS and 1-LS social theories does not refer to different domains of reality but to different ways of *navigating through data sets* (Franzosi 2004; Michel et al. 2011). 'Specific' and 'general', 'individual' and 'collective', 'actor' and 'system' are not essential realities but provisional terms that depend rather on the *ease* with which it is possible to navigate through profiles and to envelop them inside their names. The more cumbersome the navigation is, the stronger will be the temptation to handle them through the 2-LS. As long as it is difficult to reach the list of all the articles of a subfield such as 'super majority voting', one will be tempted to define it generally as 'a whole' – the very notion of 'paradigm' does just that (see below) – of which the individual

Figure I: *Detail of the 'profile' of the keyword 'self-organization'*



Note: The network is built using as nodes all keywords, authors, references and addresses of the articles which use the keyword 'self-organization' in the Web of Science© between 2006 and 2010. The size of the nodes and labels is proportional to the number of articles in which an author, institution, reference or keyword appears. Links between two nodes are created whenever these two entities appear in the same article. Weights are attributed to these links depending on the frequency of these co-appearances.

Node spatialization is performed using Gephi's ForceAtlas 2 algorithm (Jacomy et al. 2011). ForceAtlas2, a graph layout algorithm for handy network visualization). In this approach, links are interpreted as springs, and nodes which are strongly linked tend to appear close to each other. The node corresponding to self-organization has been deleted to improve readability as it was connected to all nodes in the graph.

All images are available in high quality at http://medialab.sciences-po.fr/publications/monads

professor named 'Hervé C.' is just a 'member'. It is the same thing if there is no good web site listing all the academics in this university called 'Paris School of Management'. Then, one will be tempted to say that there is a generally defined entity – for instance a 'corporate body' – whose proper name is 'Paris School of Management', which exists in relative independence from all the actors that define its envelope. This is where the two-level argument begins to take hold: one for the parts, another for the whole. It will seem irresistible to argue that to define general features, one should look at the level of structures; if one wishes to look at specificity, go to the level of individuals. However this distribution of roles between levels is a consequence of the type of technology used for navigating inside datasets.

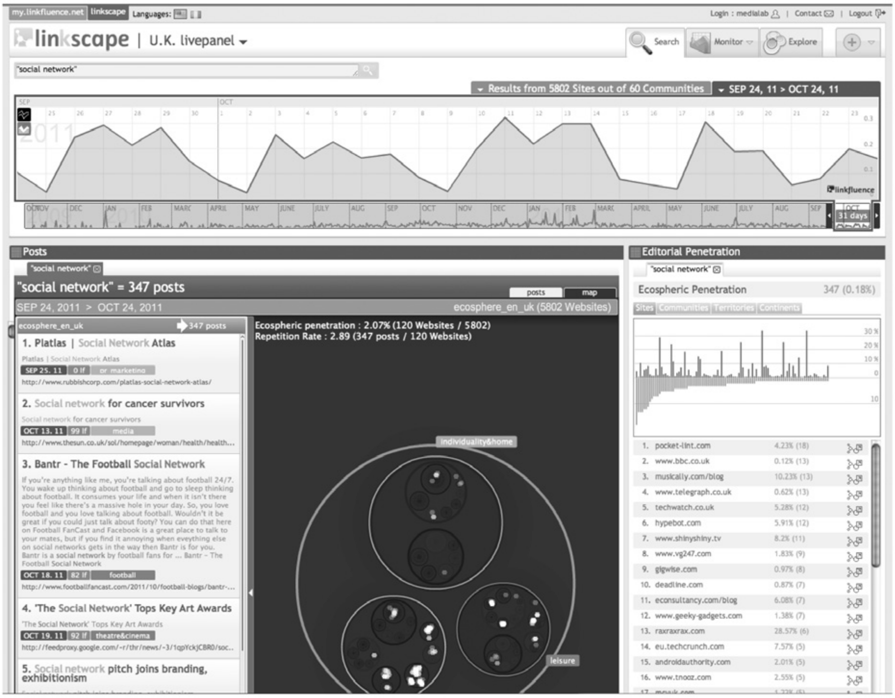
The best proof that those two levels do not correspond to any real ontological domains is that they begin to disappear, to be literally redistributed, every time one modifies or enhances the quality of access to the datasets, thereby allowing the observer to define any actor by its network and vice versa. This is exactly what the striking extension of digital tools is doing to the very notions of 'individual' and 'wholes'. The experience (more and more common nowadays) of navigating on a screen from elements to aggregates may lead researchers to grant less importance to those two provisional end points. Instead of having to choose and thus to jump from individuals to wholes, from micro to macro, you occupy all sorts of other positions, constantly rearranging the way profiles are interconnected and overlapping. This is what has been well recognized not only by ANT, but also by scholars working with network analysis (White 2008). Of course, we do not claim that digitally available profiles are so complete and so quickly accessible that they have dissolved the two levels, but that they have already redistributed them enough to offer an excellent occasion to see that those levels are not the only obvious and natural way to handle the navigation through datasets about entities taken severally. (see Figure II.)

To sum up this first section, we will claim that one is tempted to treat an entity differently from its context only because of a lack of access to the list of attributes that make up that entity. At the very least, the digitally available profiles open new questions for social theory that don't have to be framed through the individual/collective standpoint.

2. How to trace overlapping 'monads'

After having provided a flavour of our overall argument, we may now move to its more substantial and technical aspects. In 2-LS social theory, the most current approach to handling the distinction between macro-structures and micro-interactions consists in establishing a first level of individual entities, then adding to them a few rules of interaction, in order to observe whether the dynamics of interaction lead to a second level, that of aggregation, which has generated enough new properties to deserve to be called a 'structure', that is, another entity for which it is possible to say that 'it is more than the sum of its parts'. Such is the way in which most models of collective behaviour are framed, no matter if they deal with atoms, gas, molecules, insects, swarms, markets, crowds, States, artificial lives, etc. (for examples, see Moussaïd et al.

Figure II: *A typical screen experience mixing aggregated and individualized data sets*



Note: A typical screen experience with the aggregates on top, the statistics on the right hand side and the individual blogs on the bottom left with highlighted words (the example is taken from the platform Linkscape© by Linkfluence©). It is this superposition that renders synoptically coherent the two end points of so many social theories that, we claim, is the experience that should provide the occasion to rethink Tarde's ancient argument that the two end points are an artifact of the ways data are handled.

All images are available in high quality at http://medialab.sciences-po.fr/publications/monads

2009). The explanatory power and the sheer beauty of those models are tied to such a mini-max: the longest enduring structure with the lightest sets of rules.

It is important to underline here that since the seventeenth century this paradigm has been set in opposition to its apparent alternative that starts with a *sui generis* entity – for instance a body, an organ, a superorganism, an anthill, a beehive, a society, a State, etc. – in order, then, to define its individual 'parts' as endowed with 'roles' and 'functions'. Such an alternative is often called 'holistic' or 'organicist' (Weick 1995). Although the two views usually differ in the political consequences one can draw from them (Hirschman 1977), for us they are just two different ways of handling the social phenomenon by using the same 2-LS standpoint since both rely, as we shall see, on much the same data collection techniques. Their main difference is in the *time order* in which they list the three concepts: from the micro to the macro for the first, from the macro to the micro for the second. What the latter takes at its starting point, the former takes as its future horizon.

Let us take the former as our starting point since it is nowadays the most frequently used. To define the first level, the model builder has to imagine individual atoms *limited* to as few traits as possible; then to devise rules of *interactions* between those atomistic entities – again as simple as possible; then to *observe* how those interactions, after many fluctuations, *stabilize* enough to deserve the name of a structure; and then to check if this structure is sufficiently *robust* to be used as substitute for the 'wholes' that their adversaries – the holistic or organicist theorists – claim to exist before or above the 'parts' (Wilson 1975).

These are the research strategies that are followed, for example, when, against the arguments of the anthill as a super-organism, ethologists succeed in obtaining the highly complex geometry of the ant nest with only a few rules of interaction between blind ants considered as interchangeable actors (Pasteels and Deneubourg 1987; Moussaïd et al. 2009; Khuong et al. 2011). But it is also the fascinating beauty of market models when, without the push of any 'invisible hand', the sheer interaction of selfish but calculating individuals succeeds in settling on an allocation of resources more optimal than those any State would generate. Or when 'selfish genes' are said to provide a coordination of body parts that no notion of an organ superior to the cells could ever dictate (Kupiec and Sonigo 2000). Or again, what happens when sociologists manage to map out the segregation patterns of city dwellings with only two rules of attraction and repulsion among individual neighbours (Schelling 1971; Grauwin et al. 2009).

This approach can succeed in reproducing and predicting the dynamics of some collective phenomena when the individuals' behaviour can be satisfactorily described with a few parameters and fixed rules. For example, within a stadium audience the coordinated 'Ola!' wave pattern can be explained by characterizing the reactions of humans by only three states (excitable, active and passive) (Farkas et al. 2002). By calculating the transition probabilities between these states, scientists might be able to predict the size, form, velocity and stability of the emergent 'Ola!', and even how the probability of occurrence of a wave depends on the number of initiators (triggering an 'Ola!' requires a critical mass of initiators). When only a handful of parameters suffice to simulate the system's dynamics, it makes sense to treat individuals as atoms (Barabasi 2003; Cho 2009). This has proved useful to understanding some features of queues, traffic jams, panics, etc.

However, humans do not spend most of their time in queues, in traffic jams or in stampedes! To limit the grasp of quantitative social theory to just those few behaviours would be a pity. The problem with the 'atomistic' approach is that it has proved incapable of understanding more complex collective dynamics. Many reasons have been put forward to explain this: for example, human behaviour cannot generally be captured with context-independent rules which are needed to write an algorithm (Flyvbjerg 2001). But the real reason, for us, is that the project starts from a restricted vision of the social: why assume that there *first* exist simple individual agents, *then* interactions, *then* complex structures – or the opposite? Why distinguish successive moments – in whatever order?

Such apportioning is especially strange when it is not only possible but also easy to gather *a lot of information* on each of individual entity taken severally so as to draw its extended profiles. If the complexity of individual agents can be observed and handled, why would it be necessary, first, to strip individual entities of all their attributes? Why should models proceed according to the usual way by *adding* simple rules of interactions between atoms now *deprived* of the network of attributes they *possessed before*? And why should complexity be obtained, in a next step, as a provisional *whole* since it was there at the beginning? What might have appeared common sense within a different technology of data collection might cease to be so now that profiles are so conveniently available.

In 1-LS, by contrast, agents cannot be said, strictly speaking, to 'interact' with one another: they *are one another*, or, better, they *own one another* to begin with, since every item listed to define one entity might also be an item in the list defining another agent (Tarde 1903; 1999 [1895]). In other words, association is not what happens *after* individuals have been defined with few properties, but what characterize entities in the first place (Dewey 1927). It is even possible to argue that the very notion of 'interaction' as an occasional encounter among separated agents is a consequence of limited information on the attributes defining the individuals (Latour 2010).

But is there an alternative to the common sense version that distinguishes atoms, interactions and wholes as successive sequences (whatever the order and the timing)? An alternative that should not oblige the inquirer to change gears from the micro to the macro levels as is required by the 2-LS, but remains fully continuous or, as is claimed by ANT, fully 'flat'?

It appears to us that one alternative to the atom-interaction-structure is what has been called by Gabriel Tarde, in reference to Leibniz, a '*monad*' (Tarde 1999 [1895]). A monad is not a part of a whole, but a *point of view* on all the other entities taken *severally* and not as a totality. Although historians of philosophy still dispute what a monad was for Leibniz and although there exist many confusing definitions of what it was for Tarde (Milet 1970; Candea 2010), our claim is that the definition of this admittedly exotic notion may be *rendered fully operational* provided one uses the illustration offered by just the type of navigation through digital profiles we have sketched above.

This argument relies on the practice of slowly learning about what an entity 'is' by *adding* more and more items to its profile. At first the entity is just a dot (in our example it is nothing but a proper name 'Hervé C.', a clickable entry on a computer screen) but then it 'fills in' with more and more elements that specify it more and more until the observer considers that he or she knows enough and begins to take the name of the entity *for* the entire list. What has happened? In effect, we have drawn a monad, that is, a highly specific point of view – this or that entity – on all the other entities present in the dataset. The point of this navigation is that it does not *start* with substitutable individuals – as in the 2-LS – but *individualizes* an entity by deploying its attributes. The farther the list of items extends, the more precise becomes the viewpoint of this individual monad. It begins as a dot, a spot, and it ends (provisionally) as a monad with an interior encapsulated into an envelope. Were the inquiry to continue, the 'whole world', as Leibniz said, would be 'grasped' or 'reflected' through this idiosyncratic point of view.

As we saw, the crucial interest of the notion of monad – even if its exotic metaphysics is put aside – is that it is fully reversible, a feature that was impossible to render operational before the access to digital media. Each of the attributes used in order to define the entity is itself *modified* by becoming the attribute of *this* entity. In our example, whereas being 'professor in Paris School of Management' specifies who is 'Hervé C.', when we shift, with a few clicks, to 'Paris School of Management' we realize that it has become a slightly *different* academic body now that it is able to attract a 'mathematician' and a 'well known economist from abroad' to be its 'dean of academic affairs', which was not the case before. 'Paris School of Management', too, is individualized and in no way can it be taken for an element of the 'context' inside which 'Hervé C.' should be 'framed'. In other words, 'Paris School of Management' too is a monad depending on how one navigates through its profile.

What is so refreshing with the new habit of circulation is that they never end up tracing an entity as 'part of a whole' since *there is never any whole*. The reason is that with 1-LS there are, strictly speaking, *no individual atoms* (profiles are fully deployed through their attributes), *nor aggregates* (each attribute is nothing but the list of actors making it up). The experience of navigating through profiles available on digital platforms is such that when you move from one entity – the substance – to its network – the attributes – you don't go from the particular to the general, but from particular to *more* particulars.

In other words, the notion of a 'context' might be as much an artifact of navigational tools as is the notion of an 'individual' (Hagerstrand 1953; Garfinkel 2002; Latour 2005). Extend the list of items, smooth the navigation, visualize correctly the 'interior' of each monad, and you might not need the atom-interaction-structure or the actor-system apportionment at all. You will move from monads to monads without ever leaving the solid ground of particulars and yet you will never encounter atomistic individuals, except at the first click, when you begin to inquire about one item and get only an empty dot.

By now, our working hypothesis should be clear: it might be feasible to move from particular to particular and yet to obtain along the way *partial totalities* without ever relying on any of the three sets of concepts that make up the 2-LS: *there is no individual agent; they don't interact; there is no whole superior to the parts*. Such a radical conclusion is made at least plausible by the new datasets that allow entities to be individualized by the never-ending list of particulars that make them up. Such is what is meant by a monad, a point of view, or, more exactly, a type of navigation that composes an entity through other entities and, by doing so, particularizes all of them successively – 'all of them' being an open ended list the size and precision of which always depend on more inquiries and never from the sudden irruption of a superior level accessible through a brutal shift in methods.

In other words, datasets may be handled through two opposite navigational procedures: one that is based on a series of leaps of aggregation (from atoms to interaction to structure – and back), and the other one, *the monadological principle*. Introduced in social theory by Tarde through literary means and then abandoned because of the lack of empirical handles, this principle can be given a new career through the newly available techniques of digital navigation and visualization (Candea 2010).

In summing up this second section, it is important to stress that we are well aware that such an alternative definition remains highly sensitive to the quality and quantity of information available as well as to the visualization techniques at our disposal. Remember that our argument is strictly limited to the search process through data sets and that we don't consider how those attributes are gathered from 'real life'. We recognize that tracing monads will not be always feasible. For most entities, the profiling will be impossible for a number of reasons: a) our observation techniques are too rough to follow each entity individually – this might still be the case with ants in an anthill, cells in an organ, human actors in a large survey; b) the entities are really interchangeable since there is no way, even with the most sophisticated tracking device, to detect differences among them – this will be the case with atoms in a gas (Jensen 2001); c) even though it is possible to track their differences, most of the information has to be deleted or kept secret for ethical reasons – this is most often the case with telephone calls, social networks, health files, etc.; d) in spite of their claim to transparency and equality, most present day databases are rife with inequalities of status and most entrench rather crude definitions of the social world.

What we claim is simply that every time it is possible to use profiles, then the monadological principle will obtain. The reason why we insist so much on this feature is to follow another of Tarde's insights that a 1-LS social theory should in no way be limited to *human* actors. Every time inquirers have succeeded, through clever research strategy, to trace individualizing profiles of agents – baboons (Strum and Fedigan 2000), bacteria (Stewart et al. 2004), scientific papers (Chavalarias and Cointet 2009), social networks (White 2008), corporations (Stark and Vedres 2006), to take a few examples that have provided striking results – the weight of the 2-LS has diminished considerably. For instance, early primatologists considered baboons as being 'in' a strictly rigid male dominated social structure until more advanced individualizing techniques allowed the mapping out of the contribution of all the superimposed individuals revealing the striking social skills of females baboons as well as males (Strum 1987). This is the reason why, in our view, the 1-LS navigation procedure could offer a useful alternative in collecting and organizing datasets.

3. Doing away with the 'dispatcher'

After having shown how the notion of monads may modify the distribution of roles between atomistic agents and interactions, we have to tackle how it could be used as a substitute for the notion of structure – no matter if this structure appears before interactions as in holistic theories or at the end as in individualistic ones. Do we really need it to make sense of collective behaviour now that it has become easier to have access to extended profiles?

The problem comes from the baseline that is used in the 2-LS to frame this question. In its most classic version, the 2-LS approach is built on the presupposition that collective behaviours are determined by some sort of centre that we will call, to use a bland term, a *dispatcher*. This dispatcher remains always present whatever the name it has been given in the course of intellectual history: Providence, super-organism, State, body politic, natural selection, etc. Such an idea is so deeply rooted that even those who challenge its existence can't help but take it as a baseline. It is because they feel obliged to discuss the existence of this dispatcher that so many scientists, when they begin to build their models, frame the question in the following way: 'How come that those agents are able to produce an order *without* any dispatcher?'

For instance, how ants, *without* any super-organism and in the absence of central planning such as the 'spirit of the anthill', are none the less able to design such exquisitely functional nests (Wilson 1975; Khuong et al. 2011); how a stadium audience is able to go through the highly coordinated movements of the 'Ola!' *without* any centralized agent giving a signal or providing instructions for its striking wave pattern (Farkas et al. 2002); how birds in a flock, selfish calculating agents in a market, and so on and so forth, manage to reach order *without* any order being given? No ant 'sees the whole nest'; no football fan oversees the movement of the 'Ola!'; no bird envisions the whole flock; no selfish gene anticipates the phenotype that it ends up producing; no economic agent may eyeball the whole market place, etc. And yet, people seem to marvel, in the end, that there are structures and orders. So the task of social theories, they claim, is to understand how such a feat is possible 'in the absence' of any central dispatcher. In all those research programmes, the 2-LS is framing a contrast between, on the one hand, a dispatcher that could in theory obtain the same result but is in effect *absent* and, on the other, the surprising skill of each of the individual atomistic agent to 'obey' the order of a non-existing master. Is this not something short of a miracle? Indeed . . .

No matter how common sense this framing of the question has become, our view is that it has propelled many research programmes into an impasse. It implies that the structure emerging out of interactions between atomistic agents should, in the end, *emulate* what this (absent) dispatcher was supposed to do: namely, to provide orders and rules of behaviour to the agents, even though, everyone agrees, there is no such order-giving entity. As we shall see, this framing puts analysts in a double bind, forcing them to simultaneously say that the structure does the *same job* as the mythical dispatcher and yet that it is entirely different since the dispatcher does *not* exist. The net paradoxical result is to render the micro to macro paradigm indistinguishable from its purported opponent, the macro to micro. If there is no dispatcher at all, why ask from any emergent structure that it none the less fulfil the *same kind of functions* as this phantom? The subliminal existence of a dispatcher – even when it is said *not* to exist – paralyzes social theories in their search for the right way to define the key phenomenon of the social. It is the phantom that frightens research away even more surely than the myth of the atomistic individual (Tarde 1999a [1895]).

Our view is that in the same way as the 2-LS frames the individual agent as an atom and thus misses its individualizing profiles (as we saw in section 2), by framing the structure as a functional equivalent of the (absent) 'whole', the 2-LS misses even more surely what it is to be a totality. If monads are not atoms, they never 'enter in' or 'end up forming' structures either.

This argument loses its apparent flippancy when taking into consideration, once again, the practical experience of navigating through data sets. When we say, for instance, that interacting ants unwittingly produce a perfectly designed ant nest 'without' being themselves aware of the 'overall plan', we might have unwittingly confused *two* different observing points of view: that of the ant and that of the ethologist. This is what causes the disconnection in saying that ants, through their blind interactions, 'generate' the emerging structure of the nest. Strictly speaking, they generate nothing of the sort – the information on the nest they build is just another monad, an individualized nest defining the ants that live in it. What we call the 'emerging structure of the nest' is a question that interests the human observer but not the ants themselves. While, in framing the 2-LS, it seems that there exists a path leading from the first level to the other, this path is nothing but a spurious connection due to the phantom of the central dispatcher and the forgetting by scientists of their two disconnected observing standpoints. 'Atomistic-interactions-between-blind-ants-none-the-less–able-to-solve-the-problem-of-overall-social-order' is not what ants are after. If we wished to be attentive to their experience of totality, ants should be allowed to direct their attention towards an entirely different phenomenon from the phantom goal that is pointed out by the 2-LS – such is the great interest of the concept of 'stigmergy' (Theraulaz and Bonabeau 1999).

It might be even less scientific to ask ants to solve this anthropocentric question since this has little meaning even for humans (Garfinkel 2002)! Humans too should be allowed to benefit from another experience of totality. The same *non sequitur* that we might detect with ants holds for humans – or any entity for which, through the disposition of digital profiles, the monadological principle obtains. None of those entities is trying to solve the question of emerging structures any more than ants do. What they are busily after is something entirely different since each monad, by definition, possesses its own particular view of the 'whole'. What was a spurious connection for ants is also a spurious connection for humans. Ants and ANT travel along the same paths . . .

If we wish to navigate through individualizing profiles, we will have to take into account *as many wholes* as there are entities, and we should *not try* to trace a road from blind atoms to emerging structures. 1-LS social theories should be allowed to deploy another experience of totalities exactly as much as they deploy another experience of what it is to be an individual agent. Our argument is that digital techniques seem to chip away *at both ends* of what so many social theories take as their indispensable anchors, thereby offering an occasion to illustrate other views of social order (Tarde 1999b [1895]).

And yet it is difficult to loosen the impression that human agents are really different and should be treated differently to other entities. They are different but not necessarily for the reason usually put forward by those who like to extend the quantitative methods of natural sciences to human societies. Humans differ because they are often themselves equipped with many *instruments* to gather, compile, represent or even calculate the 'whole' in which they are said to reside (Desrosières 2002). This has been the key feature of ethnomethodology (Garfinkel 1967). It is also an important tenet of so many science and technology studies (STS) and the central argument of actor-network theory (ANT) that the practical instruments that allow one actor to 'see the whole society' should be taken into account for any experience of the social order (Law 2004; Latour 2005). This vast research programme has been carried out for physics (Galison 2003), biology (Landecker 2007), accounting (Power 1995), economics (Callon 1998), as well as for cartography (Jacob 2006), geography (Glennie and Thrift 2009) and even sociology (Foucault 2003). Every time, it is possible to show that *instruments* provide a highly focused but limited view of the whole, what have been called, for this reason, *oligoptica* instead of *panoptica* (Latour and Hermant 1998). Such is the type of 'stigmergy' proper to human societies.

The existence of those *oligoptica* is typical of human societies and the reason why it makes sense to speak about wholes when referring to *human* associations. Yet many different types of 'wholes' have to be considered in order to account for the peculiar obsession of human monads for describing the interactions they enter and for describing, stabilizing, simplifying and standardizing their overlapping connections (see section 5). This has little to do with moving from one level to another one, as is implied by 2-LS. It is one thing to say that ants (or birds, or cells, or atoms) do *not* benefit from those 'intellectual technologies' in order to build partial wholes while human agents do, but it is an entirely different thing to say that there exists a second level, that of the whole that would be *common* to both ants and humans. The two arguments don't follow from one another at all.

To capture what is none the less a real difference with humans (especially highly scientificized and technicized human collectives), let's say that monads are best captured through a 1.5 level standpoint (1.5-LS). By this expression we mean to say that a) even though each monad has its own version of the totality, a series of intellectual and technical instruments exists to foster the overlapping of different individual definitions, without those various definitions ever coalescing into a second level that would unify all of them; and that b) this is what explains the impression that there is 'more' in collective actions than what exists in individuals taken in the atomistic sense of the word. This expression of 1.5-LS is simply a way to remind the reader of our general argument that the two endpoints of so many social theories might have lost much of their relevance when something else, the monadological principle, offers another experience of navigation through digital data sets.

The conclusion of this third section is that another experience of 'being in a whole' should be explored that has little to do with 'being a part' of a 'structure' no matter if this structure is a *sui generis* super-organism or an emerging level.

4. How to navigate through overlapping monads

After having seized the occasion of digital tools to test Tarde's alternative definition of atoms, interactions and structures, we might now be better equipped to see whether we can render operational his notion of overlapping monads by visualizing them in a coherent way. It is our contention that most of the arguments against the 1-LS and 1.5-LS (and more narrowly against Tarde's unexpected come back) are due to the lack of efficient visualizing tools. In their absence, even though there exists an alternative to the 2-LS, it is the only one that seems acceptable as a fall back.

To go some way toward answering the first question, we will use the example of *scientific paradigms*. Their study benefits today from a level of quality and availability of information unmatched in other domains of collective behaviour: almost every word written by every author in every paper cited by any later text is accessible in a few clicks in digital format (Grauwin et al. 2009; Grauwin 2011; Grauwin et al. 2012; Cointet 2009). This choice is the more reasonable since it has been at the heart of much STS (Merton 1973) (and the preferred example of Tarde . . .). One might even argue that the level and precision of information that, before the advent of digital tools, were accessible only for the spread of scientific keywords and concepts through papers and citations, have now become the standard for all sorts of individualizing profiles – a seminal idea that has not been lost on the founders of Google (Brin and Page 1998).

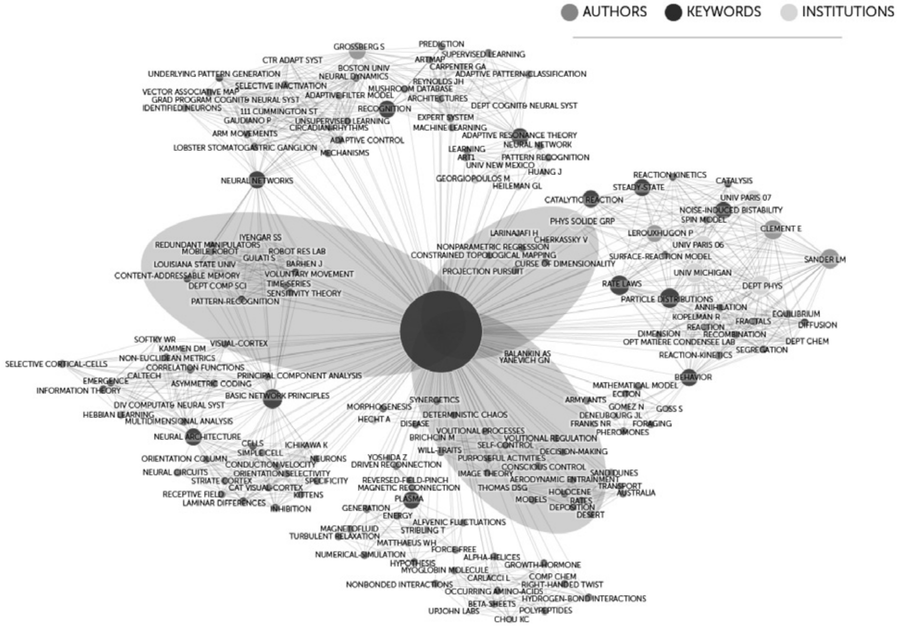
Let's follow the navigation through profiles to answer the question: 'What does it mean to be 'part of' a paradigm P?' According to the monadological principle, the departure point matters little since from every entity we will end up visiting the list of all its attributes grasped from this specific point of view: we may start at will from one scientist, one paper, one keyword, one institution or one experimental method. Let us begin in the case of 'self organization' from papers with keywords and citations (Grauwin 2011).

So the problem now becomes how to map out as many wholes as there are parts, that is, monads. Instead of partitioning atoms, then interactions, then structures, we now want do draw *intersecting* monads where some attributes in one list are also visible in some other entity's list (Figure III). Instead of the common research strategy: 'Go from simple interactions to more complex structures' we wish to apply a counterintuitive one: 'Start with complex overlapping monads and detect the few attributes they share'.

It is true that by proposing such a navigation we move away from the dream of simulation and prediction and explore another path, that of *description* where the added value is no longer the power of prediction, but the progressive shift from confusing overlaps to successive clarifications of provisional wholes. Instead of trying to simulate and predict the social orders, we wish to acknowledge the limitations of the simulation approach for collective systems and prefer letting the agents produce a dynamics and collect the traces that their actions leave as they unfold so as to produce a rich data set (Grauwin 2011). In other words, data mining does not result in the same scientific habits as simulation: instead of asking how global structures emerge from local interactions, we propose to illustrate a navigational tool that shifts the attention of the observer from confusing overlaps to the few elements that travel from one monad to the next, much in the same way as standards do in technological systems (Gleenie and Thrift 2009).

Before complaining that this is too confusing, one should remember how confusing it was to have, first, to specify a general structure (the paradigm of self organization), and then to qualify it by endless individual idiosyncrasies that 'didn't fit' into the picture. Thomas Kuhn, who first introduced the notion

Figure III: *Keyword 'self-organization' considered as a partial 'whole'*



Note: Keyword 'self-organization' considered as a 'whole' produced by the intersection of articles that are far richer than this single keyword. We use the same procedure as in Figure I, but limit the visualization to the 18 articles published in 1991 and omit the articles' references. To highlight the idea of 'intersection', the attributes of three 'monads' (articles) are shown enclosed by an ellipse.

All images are available in high quality at http://medialab.sciences-po.fr/publications/monads

of paradigm, knew fairly well how clumsy it was, and every scientist knows how difficult it is to draw precisely the domain in which he or she works. Is it possible to do justice to such a common experience by shifting from prediction and simulation to description and data mining? Our approach suggests a way of navigating through these datascapes with a monadological point of view, which can capture the richness of associations while remaining faithful to the complexity of agents.

This is where the question of visualization becomes so crucial: Is there a comprehensible space in which idiosyncratic monads may be projected that could reveal their intersecting features without losing their specificity? To explore this possibility we have to take into account two common practices in handling data sets.

The first is the very humble and often unnoticed gesture we all make when we surround a list of features with a circle (a shape often referred to as a 'potato'!) and decide to say that all those elements are 'roughly similar' and may share the same name (it does not matter here if this is done by eyeballing data or through highly sophisticated calculations of correspondences). The point is that we should be able to draw such a circle without leaving the 1-LS since the whole is not the structure to which the elements will be said to pertain as in the 2-LS but *another monad* just as specific as the other that 'makes it up'. (Remember the example of how to define 'Paris School of Management' in section 1). The gesture of adding a circle is simply the recognition of the outside limit of a monad – whose envelope, we should remember, is defined by the list of all its individualizing attributes – and not the delineation of the 'role' it 'plays' 'inside' a 'structure'. To say it in other words, in a 1-LS world the borders of monads should be defined by the provisional end of the expansion of their content and not by adding a category coming from elsewhere.

The second practical experience to take into account is that many new movements through datasets are possible *on screen* that were not possible when manipulating paper (a feature that make *writing* articles on this topic very tricky indeed!). The projection of intersecting monads ceases to be so confusing if it is possible to highlight each of them in succession and to detect how each of them contribute to the overlapping set (see the accompanying film http://medialab.sciences-po.fr/publications/monads/video). As we said above, it is this new navigational skill that has made the two end-points of 'individual agent' and 'structure' less relevant than the superposition of actors-networks highlighted in succession (see Figure III).

If we take into account the experience of digital navigation, what happens to the notion of 'whole'? When we navigate on a screen, zooming in and out, changing the projection rules, aggregating and disaggregating according to different variables, what stands out is what remains constant through the shifting of viewpoints (Gibson 1986). This is our 'whole'. As expected, its size has shrunk considerably! Instead of being a structure more complex than its individual components, it has become a *simpler* set of attributes whose inner composition is constantly changing. The whole is now much smaller than the sum of its parts. To be part of a whole is no longer to 'enter into' a higher entity or to 'obey' a dispatcher (no matter if this dispatcher is a corporate body, a *sui generis* society, or an emergent structure), but for any given monad it is to *lend part of itself* to other monads without either of them losing their multiple identities.

To sum up this section, we are now left with two opposite ideas of what it is to analyse complex collective phenomena. In the 2-LS, it is possible to build a model on condition that one begins with simple atoms interacting through simple rules and test whether some stable structure emerges in the end. In the 1-LS, you begin, on the contrary, from highly complex actor-networks that don't exactly 'interact' but rather overlap with one another, and you extract from those overlapping sets the attributes that some of them share. If the data navigation techniques we are proposing work – and it is a big 'if' – we will have succeeded in mapping a collective phenomenon without ever considering either individual components or structure. In which case, we would have vindicated the insight Tarde could not render operational because of the absence of digitally available data . . .

5. Learning to visualize partial 'wholes'

What does it mean to follow a collective phenomenon in the 1-LS navigational procedure? When one observer begins to quickly transform a clickable dot into a fully defined monad by listing its attributes, he or she is *already* dealing with a collective phenomenon (though in a sense that does not resemble the 2-LS definition of collective). The observer is gathering successive items and *encircling* them *inside* what has become the proper name of a specific monad. As such he or she is dealing with an 1-LS collective, or better, a *collecting* activity: it is *this* monad that gathers, assembles, specifies, grasps, encapsulates, envelops those attributes in a unique way.

So, whereas in 2-LS some agents are designated to play the role of 'parts' while others are said to be 'wholes', when navigating through profiles in 1-LS we don't introduce any difference between entities. In the example above, any thread may be chosen as our departing point for defining a paradigm: a researcher, a paper, a university, a concept or a keyword. Each of them is equally a 'part' and a 'whole', that is, a monad (or an actor-network). In other words, each entity is entitled to have its own curriculum vitae, that is, its own trajectory through successive attributes.

The fact that in 1-LS all entities have the same status does not mean that they are all the same. It is a common experience while navigating a dataset that some entities recur more often than others. For example, in section 1 we said that 'Paris School of Management' entered into the profile (or the curriculum vitae) of 'Hervé C.' According to our data set however, we may also notice that it appears in the profiles of 'Dominique B.' and 'Pierre-André R.' etc. We know that this repetition does not mean that it is a 'structure' of which those three academics would simply be 'members' even though we might be tempted to shorthand this list by stating things just this way thus falling back on the 2-LS. What we want is to remain in a 1-LS or in 1.5-LS.

To understand why we should resist the temptation of shortcutting this series of repetitions by treating them as an emerging structure, consider the fact that each time 'Paris School of Management' is listed in the profile of another monad it is repeated *with variations*. As we said in section 1, every time an entity is associated with a new monad, it's individualized through the *previous* associations gathered by that monad. The 'Paris School of Management' *of* 'Hervé C.' is modified as much as by being the 'Paris School of

Management' *of* 'Dominique B.' Thus what we now have is a new file made up of the *repetition* of the same attributes *plus the variations* it has undergone in each of the composing monads. Such a file is what social scientists are used to call an 'institution', an 'organization', or, more blandly, a group.

This new point needs to be tackled with a great many precautions because, in the 2-LS, it has been confused with that of structure conceived as higher-level entities mysteriously emerging from lower-level interactions. Emerging *on another level*, structures are said to be independent from the interactions that generated them and yet able to send orders, to define place, to attributes roles to the 'parts' in the way expected from dispatchers. It is this confusion that has created the idea of a 'corporate body' of which the passing humans would simply be provisional 'members'. Many a moving speech has been given by deans about the contrast between, for instance, the 'long lasting body' of the University and the quick turn over of its transitory mortal occupants – a two-level standpoint if any . . .

In 1-LS, institutions are nothing like structures, they are just a trajectory through data starting from a different entry point in the database: instead of asking which institutions are listed in the profile of particular individual, we ask which individuals are listed in the profile of an institution. It is the same matrix but not the same navigation: the 'wholes' are nothing more than several other ways of handling the interlocking of profiles. It is this type of navigation to which Tarde gave the confusing name of 'imitation' and this type of spread he called 'imitative rays' (Tarde 1903; Sperber 1996). If we are right, 'imitation' for him is not first of all a psychological phenomenon, but the realization that monads share attributes modified by each sharing, the result of which is a list made up of the 'same' item repeated *with difference* (Deleuze 2005).

There is therefore no substantial distinction to be introduced between individuals and groups or institutions. The only difference in what we call institutions is the one monad that recurs *more often* in the database – and this detection is empirical and depends entirely on the quality of the database. In the example we used in the introduction of this paper, the only thing that distinguishes 'Paris School of Management' from 'Hervé C.' is the fact that the former might be counted *more times* than the latter . . . If in the dataset an attribute is cited more often, then *it is* an organization, that is, what is distributed through a multiplicity of monads without itself being more complex than any of them – much in the manner of a circulating standard. If Hervé C. was cited more often than his school, he would be *that* institution . . .

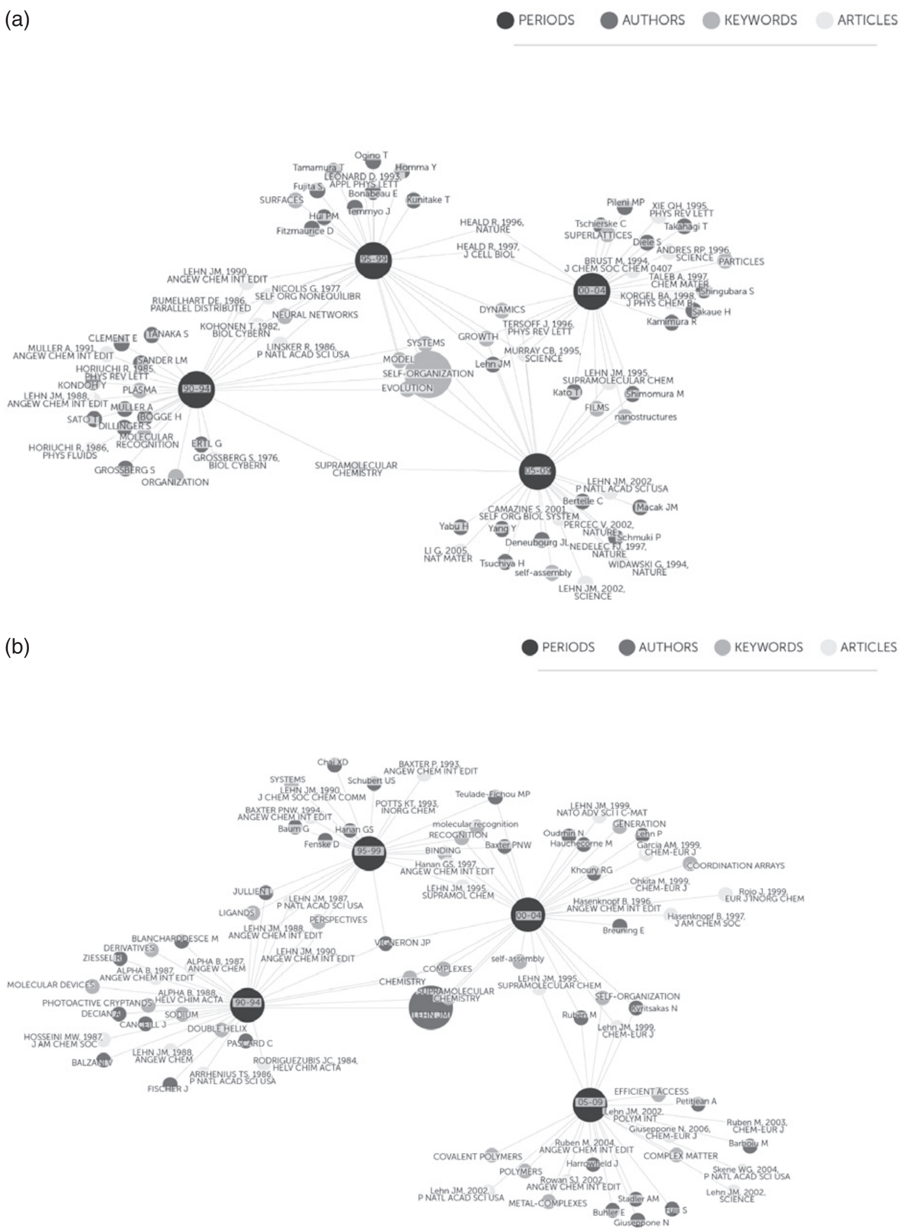
If this purely quantitative difference seems too extreme, we should be aware that 'organizations' and 'participants' like all the other terms we have gone through in this paper – 'parts', 'wholes', 'individual', 'structure', 'members', 'monads' – are nothing but *ways of navigating* through limited datasets. Individualizing, collecting, grouping, and coordinating are so many trails left by search engines through profiles made up of attributes encapsulated in names as shorthand. As Tarde so vividly described, all those canonical terms of social theory are simply the registration of *quantitative* differences in the relative spread of attributes (Tarde 1903; Latour 2010).

Such a definition of a group may solve a conundrum that has made it very difficult to focus on the main phenomenon of the social – and may also help visualizing the 1-LS. 2-LS theories are often based on the contradictory idea that the macro level is made of *virtual* but *stable* entities while the micro level is made of *real* but *transitory* entities. Paradoxically, what lasts longer is said to exist only virtually, while what 'really' exist does not seem to be made to last . . . A strange type of definition that goes a long way toward explaining the mystery surrounding collective phenomena, be they those of cells in a body (Riboli-Sasco 2010), ants in anthill or actors in society (Karsenti 2006).

In the 1-LS, on the contrary, there is no paradox about the fact that the profiles that last are made up by attributes that *do not last* (Debaise 2008). If this process seemed mysterious, it is only because we tried to explain it with the wrong distinction – the one between the virtual and the real, the macro and the micro, the general and the particular – instead of explaining it with the distinction between what is *passed* from one monad to the other and the transformation undergone by what is passed. If 'Paris School of Management' lasts, it is not because it is above or even different from the composing monads. It is because it is *repeated with variations* from one monad to the next: enough repetition to be recognizable as the same; enough variation to be carried along further in time and space. Far from existing on a higher, virtual level, what we call institutions, organizations or groups are nothing but the effort of monads to make some of their attributes flexible enough to be translated by a great many other monads and yet stable enough to be recognized through their transformations (Figure IVa and b). The work necessary to trace the borders of an entity and assign it a proper noun is part of such effort, as well as the work of preserving the continuity of such names and boundaries (White 2008).

Once again, we have to understand that encircling a bundle of traits with a shape does not mean that a structure is taking over but simply that the *limit* of a monad is being reached and underlined. Inside this circle, everything might change through time: for instance 'self-organization' at time zero may be made up of the keywords, authors, and concepts A, B, C, and after a few iterations it might transformed to include X, Y, Z. Every single item composing successive 'self-organization' profiles may change and the name may change as well (what we call 'self-organization' today used to be something entirely different a few decades ago). What matters is that the change be gradual enough to preserve some continuity. Everything may change, but not at the same time. We should not say: 'And yet it is the *same* self-organization bundle' as if, through those changes, something, the structure, had remained the same (although virtually). We should say: 'Look, on the contrary, how different it is; but because of the

Figure IV: *(a) and (b): Gradual evolution of the 'whole' defined by the keyword 'self-organization' from 1990 to 2009*



[**Figure IV:** *Continued over*]

Figure IV: *Continued*

Notes: (a). For each 5-year time slice (●), we choose the 10 most prolific authors (●) and the 10 most used references (●) and keywords (●). Authors, keywords or references are linked to the 5-year time slice in which they appear. The figure shows that, although most entities (authors, keywords or references) change through time, each time slice inherits something from its predecessor. For example, in the 1990s, scientists interlocked their definition of self-organization through 'neural networks', while in the 2000s, 'growth' of 'nanostructures' became a more powerful link. This operation is perfectly reversible, as shown in Figure IV (b) by taking the example of author J.M. Lehn, a chemistry Nobel Prize winner. Proceeding in exactly the same way as in Figure IV (a), we show that, while JM Lehn remains connected through all these years to 'Supramolecular Chemistry' and 'Complexes', his co-workers change. So do his main fields of interest, shifting from 'Double Helix' or 'Ligands' in the 1990s to 'Self-assembly' in the 2000s. Both Figures show that the arrow of time is not necessarily linear (which would show as a linear arrangement of ●), but is somewhat circular because several items occur throughout the years, building an effective attraction between the first 5-year time slice and the last.

All images are available in high quality at http://medialab.sciences-po.fr/publications/monads

ways participants have interlocked their definitions, each change has *inherited* something from its predecessor through a channel that can now be traced by clicking on the profile of this participant'. Once again, a different navigation generates a different definition of what is a collective, that is, a *collected* entity. Strictly speaking, we should stop talking of collective phenomena distinct from individual ones, but only of many different types of *collecting* phenomena.

6. Conclusion

In this paper, we have seized the occasion given by the sudden proliferation of digital databases to revisit an ancient social theory proposed by Gabriel Tarde before the availability of large statistical tools and before the entrenchment of many social theories within the 2-LS paradigm. It is because those databases provide the common experience to define the specificity of an actor as tantamount to expanding its network, that there is a chance to escape from choosing between what pertains to the individual and what pertains to the structure. Monads dissolve the quandary, and redefine the notion of the whole by relocating it as what overlapping entities inherit from one another.

We are well aware that those data bases are full of defects, that they themselves embody a rather crude definition of society, that they are marked by strong asymmetries of power, and above all that they mark only a passing moment in the traceability of the social connections. In addition, we are painfully aware of the narrow constraints put upon them by network analysis and by the limitations of the visualizing tools available today. But it would be a pity to miss this occasion to explore such a powerful alternative that may provide another way to render the social sciences empirical and quantitative without losing their necessary stress on particulars.

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Note

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