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HAYEK ON EXPECTATIONS: THE INTERPLAY BETWEEN TWO COMPLEX SYSTEMS

Documents de travail GREDEG
GREDEG Working Papers Series

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GREDEG WP No. 2016-13
http://www.gredeg.cnrs.fr/working-papers.html

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Hayek on Expectations: The Interplay between two Complex Systems

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GREDEG Working Paper No. 2016-13

Abstract – In this paper we argue that Hayek's expectations approach can be better understood by taking account of the interplay between two related complex systems: the complex system of cognition and the complex system of behavioral rules of action.

The former is located at the individual level and concerns the way human beings perceive the physical world as and well as their fellow men. The second one concerns how human beings behave (essentially how they follow rules) and form expectations based on the properties of their cognitive systems, such that the system of rules to which they adhere provides higher order regularities which preserve their existence over time, that is, the existence of societies.

The article is organized as follows. Section 1 provides a detailed description of these complex systems and emphasizes their differences. Section 2 deals with the interplay between these two systems, and discusses the consequences of forming expectations. Section 3 sums up the paper's main arguments.

Keywords: Hayek, emergence, complexity, knowledge, expectations

JEL codes: B25, B4, B53, D84

Introduction

In *The Counter-Revolution of Science*, Hayek (1952b, 31) points to some emerging problems accompanying advances in subjectivism in relation to economic theory, including "the problem of the compatibility of intentions and expectations of different people, of the division of knowledge between them, and the process by which the relevant knowledge is acquired and expectations formed." Analyzing Hayek's view of expectations is interesting in particular because it challenges a set of received ideas.

First, it has been claimed that expectations are one of the main reasons for the relatively small attention paid to Hayek's business cycles approach (Hayek [1929], Hayek [1931]). It is argued that Hayek's theory of business cycles approach is flawed in that it does not confirm to the scientific norm of rational expectations (see Bilo, 2014).

In our view, Hayek's expectations approach cannot be reconstructed through the lens of rational expectations theory. Zappia (1999) explains, that as early as the mid-1930s when challenged by Morgenstern's (1936) critique of his article on intertemporal price equilibrium (Hayek 1928), Hayek was aware that equilibrium in the expectations of individual agents requires not only an assumption about the agent's foresight capabilities but also that the assumption is itself an equilibrium notion.

In this paper we show that such a perspective is compatible neither with Hayek's conception of individual cognition and behavior nor with his non-teleological evolutionary approach.

Second there is a received idea that Hayek's writings on expectations are a set of apparently unrelated – and difficult to reconcile – contributions illustrating what Hutchison (1981) had called Hayek's methodological "U-turn". At first sight, it might seem that Hayek's perspective on expectations changed over time, switching from the norm of stationary

equilibrium in his 1928 article to "a state of mutual consistency of plans with correct foresight" in his 1937 article. However, on closer investigation, it is clear that Hayek's writings on expectations are marked by a continuous search for the development of a general theory of expectations, able to go beyond general equilibrium theory, and focusing on the circumstances of time and space as well as the coordination of interpersonal subjective action plans.

We argue in this paper that in order to grasp Hayek's expectations approach it is necessary to understand the interplay between two related complex systems: the complex system of cognition and the complex system of behavioral rules of action.

The former is located at the individual level and concern the way human beings perceive the physical world as and well as their fellow men.

The second one concerns how human beings behave (essentially how they follow rules) and form expectations based on the properties of their cognitive systems so that the system of rules to which they adhere provides higher order regularities which preserve their existence over time, that is, the existence of societies.

The article is organized as follows. Section 1 provides a detailed description of these two complex systems and emphasizes their differences; section 2 discusses the interplay between these systems and the consequences of forming expectations; section 3 summarizes the paper's main arguments.

1. The articulation between two complex systems

In this section we describe the two complex systems which Hayek was interested in, i.e., the cognitive system, and the system of rules of conduct, and stress the main differences between them.

1.1 The cognitive complex system

Hayek's view of individual cognition is based on *The Sensory Order* (1952a – *TSO* hereafter), a contribution he made to theoretical cognitive psychology in the 1920s but which was not published until 1952[1]. Hayek contemporaneously described *TSO* as "the most important thing I have ever done" (letter to John Nef, dated 6 November 1948, cited in Caldwell, 1997, p. 1856). Unfortunately, as Butos and Koppl (2007) note, despite the recognition received by Hayek's cognitive theory from outside of economics from scholars such as Gerald Edelman[2], Joaquin Fuster, and Edward Boring, its influence on researchers in economics and social science can be described as at best tangential (Butos and Koppl, 2007, 35). However, although its consequences are far from negligible, the method Hayek applies in this book is

[1] The curious context in which Hayek developed his ideas is worth noting. In the winter of 1919-1920 a fuel shortage and forced closure of the University of Vienna presented Hayek with an opportunity to spend a few weeks in Zurich working in the laboratory of the brain anatomist Constantin von Monakow, tracing fiber bundles of the brain (cf. Hayek 1994, p. 55). A few months later, Hayek wrote the initial working material for *The Sensory Order*, a student paper manuscript entitled "Beiträge zur Theorie der Entwicklung des Bewusstseins".

[2] Gerald Edelman who won the Nobel Prize in Physiology in 1972 confesses that he was inspired by some of Hayek's ideas on neuronal selection: "I must say that I have been deeply gratified by reading a book [Hayek's *The Sensory Order*] of which I had not been aware when I wrote my little essay on group selection theory (…). I was deeply impressed (…). I recommend this book to your [i.e. The American Academy of Arts and Sciences] attention, as an exercise in profound thinking by a man who simply considers knowledge for its own sake. What impressed me most is his understanding that the key to the problem of perception is to comprehend the nature of classification. Taxonomists have struggled with this problem many times, but I think Hayek considered this problem in a broader sense." (Gerald Edelman, "Through a Computer Darkly: Group Selection and Higher Brain Function", *Bulletin — The American Academy of Arts and Sciences*, Vol. XXXVI, No. 1, Oct. 1982, p. 24). Other scientists outside economics have praised Hayek's contribution. According to Steele (), Hayek's *The Sensory Order* foreshadowed Henry Potkin's evolutionary epistemology.

often overlooked. *TSO* is built using General System Theory which Hayek takes from von Bertalanffy (1969)[3]. He uses both anecdotal evidence and theoretical arguments to illustrate his idea. First, in the preface to *TSO* Hayek pays tribute to his "friends Karl R. Popper and L. von Bertalanffy and to Professor J.C. Eccles"[4], to whom he considers he is "much indebted for [their] reading and commenting upon earlier drafts of [his] book" (Hayek 1952a, ix). Second, Hayek's article 'Primacy of the abstract' (Hayek 1969), was first published in a book edited by Arthur Koestler and John Raymond Smythies which contains contributions to the Alpbach Symposium[5] organized in 1968 by Arthur Koestler on 'New perspectives in the Science of Man'. Among the participants and authors were Jean Piaget and Ludwig von Bertalanffy known as defenders of structuralism and system theory respectively[6].

From a theoretical view point, Hayek's *TSO* is organized on principles that are in line with Bertalanffy's General System Theory applied to biology:

> Any attempt to explain the highly complex kind of purposive action made possible by a developed central nervous system may be premature so long as we do not possess a fully adequate biological theory of the *comparatively simpler kind of purposive functioning* (…) [L. von Bertalanffy's] theory of 'open systems' in a steady state (*Fliessgleichgewicht*) in which 'equifinality' prevails because the equilibrium that will be reached will be in some measure be (*sic*) independent of the initial conditions, seems to provide the most helpful contribution to this problem. (Hayek 1952a, 83; emphasis added).

[3] For a more complete analysis of the relationship between Hayek and von Bertalanffy, see Lewis and Lewin, (2015) and Lewis (2016).
[4] J.C. Eccles won the 1963 Nobel Prize in Physiology or Medicine for his work on the synapse.
[5] "The European Forum Alpbach took place for the first time in August 1945 as one of the earliest international political and intellectual events in post-WWII Europe. Its founders were Otto Molden, who had been active in the resistance movement during the Second World War, and philosophy lecturer Simon Moser from Innsbruck, as well as a number of other influential personalities." (http://www.alpbach.org/en/about-us/unsere-geschichte/).
[6] During this symposium, Koestler brought together many important thinkers, such as Ludwig von Bertalanffy, Viktor Emil Frankl, Friedrich August Hayek, Jean Piaget, William Homan Thorpe, Conrad Hal Waddington, and Paul Alfred Weiss.

Let us now describe three of the main features of the cognitive complex system.

First, we emphasize the distinction Hayek makes between the physical order, the neural order, and the sensory order. Second, we stress that the logic of the cognitive system is based on hierarchical successive classifications. Third, we show how what Hayek calls the 'map' and the 'model' combine in order to generate individuals' perceptions of their environment.

a. The distinction between the different orders

Early in his book Hayek distinguishes the physical order (i.e., the domain of external stimuli) from the sensory order or the mind defined as "*a particular order of a set of events taking place in some organism and in some manner related to but not identical with, the physical order of events in the environment*." (Hayek 1952a, 16; original emphasis). For him there is a fundamental discontinuity between these two orders which nevertheless had to be related in some way in order to avoid a circular explanation (see below for more detail).

On the one hand, the sensory order forms a "*self-contained system* so that we can describe any one of these qualities only in terms of its relations to other such qualities, and that many of these relations themselves also belong to the qualitative order" (Hayek 1952a, 37, emphasis added). On the other hand, there is no one-to-one correspondence between the physical order (i.e., external stimuli) and the sensory order (i.e., the experience of a sensation). As Caldwell (2004) emphasized, Hayek's endeavor in *TSO* was to challenge the dominant doctrine in psychology known as the 'doctrine of psycho-physiological parallelism' endorsed by Ernst Mach and a few others in Vienna.

More precisely, Hayek distinguishes three orders whose relations have to be clarified (see figure 1):

- First, “the physical order of the external world, or of the physical stimuli” (Hayek 1952a, 39);
- Second, “the neural order of the fibres, and of the impulses proceeding in these fibres, which though undoubtedly part of the complete physical order, is yet a part of it which is not directly known but can only be reconstructed” (ibid);
- Third, “the mental or phenomenal order of sensations (and other mental qualities) directly known although our knowledge of it is largely only a ‘knowing how’ and not a ‘knowing that’, and although we may never be able to bring out by analysis all the relations which determine that order”[7]. (ibid).

Hayek specifies the relations among these three orders by having recourse to the notion of isomorphism, an idea he borrows from the Gestalt School but which is qualified in order to restrict it to a topological – and not a spatial – mathematical meaning[8]. In other words, an isomorphism between two systems of related elements means that the two systems are similar with respect to the topological positions of their elements within the system but that this implies nothing about any other property of the elements of these two systems. An isomorphism preserves the properties between the elements of the two structures (Hayek 1952a, 37-40).

According to this definition, the neural order (the second one) and the mental order (the third one) are isomorphic. Therefore, since there is no one-to-one correspondence between the

[7] For the distinction between ‘know how’ and ‘know that’ Hayek refers in a note to Ryle (1945) who introduced this distinction.

[8] According to Hayek the notion of isomorphism “will be used in its strict mathematical meaning of a structural correspondence between systems of related elements in which the relations connecting these elements possess the same formal properties” (Hayek, 1952a, p. 38). In mathematics an isomorphism is a specific morphism. A morphism satisfies the following two axioms:
Identity: for every object X, there exists a morphism $\mathrm{id}_X\colon X \to X$ called the identity morphism on X, such that for every morphism $f\colon A \to B$ we have $\mathrm{id}_B \circ f = f = f \circ \mathrm{id}_A$.
Associativity: $h \circ (g \circ f) = (h \circ g) \circ f$ whenever the operations are defined.
$f\colon X \to Y$ is called an isomorphism if there exists a morphism $g\colon Y \to X$ such that $f \circ g = \mathrm{id}_Y$ and $g \circ f = \mathrm{id}_X$. If a morphism has both a left-inverse and a right-inverse, then the two inverses are equal, so f is an isomorphism, and g is called simply the inverse of f.

physical order and the phenomenal order, the physical order (the first one) cannot be isomorphic to the neural order (the second one). This does not mean that they are unrelated. Hayek refers to the more vague notion of similarity (which could be interpreted as approximation of the mathematical notion of mapping or correspondence[9]) in order to account for the fact that the mind provides an interpretation but not an exact description of the physical world[10].

Note that Hayek's specification avoids circular reasoning since the neural order which is a sub-set of the physical order, is isomorphic to the mental order.[11]

In less abstract terms the sensory order is a combination of the neural and mental orders which are defined as equivalent. The relations between the physical and the neural orders are mediated through *stimuli*, whereas the relations within the neural order are linked by *impulses*[12].

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[9] A correspondence is an ordered triple (X,Y,f), where f is a relation from X to Y, i.e. any subset of the Cartesian product $X \times Y$.

[10] This idea is perfectly summarized by Edelman (1989, p. 32): "A closed universal description of objects is not available to an adaptive creature, even to one with concepts; there is no 'voice in the burning bush' telling that animals what the world description should be."

[11] "It should be pointed out at once, however, that our use of the term isomorphism, though useful for the purpose of exposition at this stage, will in the end prove somewhat inappropriate. We are at present concerned with relations of an inferred order, the terms of which are unknown (since they are left without attributes if we regard all mental attributes as determined by relations), with an order which might be established between known neural elements. We shall, in fact, come to the conclusion that the two orders are not merely isomorphous but identical and that to postulate a separate set of terms for the mental order would be redundant" (Hayek, 1952a, p. 40). Strictly speaking this is exact. In fact the two orders (the neural order and the mental one) are in some sense identical inasmuch as the properties between the elements of the two orders are the same. This is in line with the idea that "our account of the translation of the neural impulse into a mental event as a process of classification leads us to expect that we will find that this process not only takes perceptible time but also that it can be observed in different successive stages in which the classification or evaluation developed to different degrees" (Hayek, 1952a, p. 148).

[12] "The term *stimulus* will be used throughout this discussion to describe an event external to the nervous system which causes (through or without the mediation of special receptor organs) processes in some nerve fibres which by these fibres are conducted from the point at which the stimulus acts to some other point of the nervous system. It appears that at least some receptor organs are sensitive not to the continuous action of any one given stimulus but only to changes in that stimulus. Whatever it is that is produced in the nerve fibre and propagated though it we shall call the *impulse*" (Hayek, 1952a, p. 8).

b. The logic of the cognitive system is based on the principle of increasing classification.

The logic of classification reflects the relations that take place in the cognitive system between events and effects:

> By 'classification' we shall mean a process in which on each occasion on which a certain recurring event happens it produces the same specific effect, and where the effects produced by any one kind of such events may be either the same or different from those which any other kind of event produces in a similar manner. All the different events which whenever they occur produce the same effect will be said to be events of the same class, and the fact that every one of them produces the same effect will be the *sole* criterion which makes them members of the same class. (Hayek, 1952a, 48).

Accordingly, classification is defined as a binary relation on the set of events. This binary relation is defined as 'to have the same effect.' What is important to note is that the events belong to the set of impulses, i.e., they are parts of the neural order[13]. As far as the effects are concerned, they are not reduced to behavior (as behaviorism would assume) but defined in terms of sensory qualities in the mental order:

> Once we include among the 'effects' of a stimulus all the intermediate links which may intervene between the stimulus causing a sensation and the overt response to it, the difficulty of defining sensory qualities in terms of their effects largely disappears.

[13] "Any individual neural event may have physical properties which are similar or different from other such events if investigated in isolation. But, irrespective of the properties which those events will possess by themselves, they will possess others solely as the result of their position in the order of inter-connected neural events. As an isolated event, tested for its effects on all sorts of other such events, it will show one set of properties and therefore have to be assigned a particular place in the order of classification of such single events; as an element of the complete neural structure it may show quite different properties" (Hayek, 1952a, p. 46).

(Hayek, 1952a, 45)

In compliance with the logic of multi-level systems in cybernetics, classification is a hierarchical process[14]:

> The classification may thus be 'multiple' in more than one respect. Not only may each individual event belong to more than one class, but it may also contribute to produce different responses of the machine if and only if it occurs in combination with certain other events. Different groups consisting of different individual events may in this manner evoke the same response and the machine would then classify not only individual events but also groups consisting of a number of (simultaneous or successive) events. In this latter case the groups (or sequences) of individual events would as groups constitute the elements of the different classes. (Hayek, 1952a, 50).

Furthermore, due to its reflexivity, the logic of classification is 'multiple' in a third sense: "it can take place on many successive levels or stages, and any one of the various classes in which an impulse may be included may in turn become the object of further classification" (ibid, 70).

Finally, the logic of classification is dynamic since it is characterized by the potentiality of reclassification: "The reclassification, or breaking up of the classes formed by the implicit relations which manifest themselves in our discrimination of sensory qualities, and the replacement of these classes by new classes defined by explicit relations, will occur whenever the expectations resulting from the existing classification are disappointed, or when beliefs so

[14] "This classification is determined by the position of the individual impulse or group of impulses in a complex structure of connexions, extending through a hierarchy of levels, follow certain important conclusions concerning the effects which physiological or anatomical changes must be expected to have on mental functions" (Hayek, 1952a, p. 147).

far held are disproved by new experiences" (Hayek, 1952a, 169).

The logics of classification and reclassification give to the cognitive complex system a high degree of plasticity and provide it with the property of homeostasis by means of negative feedback processes[15]. These negative feedback processes consist of the correction of errors due the possible existence of a difference between expected and experienced effects (see section 2.1).

Classification then is an emergent[16] property of the mind. As Lewis (2012, 372) stresses, "Hayek's analysis suggests that the capacity to classify stimuli arises only when the individual nerve fibres are arranged so as to form a structured, hierarchical whole. That capacity is, therefore, an emergent property. Its bearer is the higher-level or emergent entity, namely the human mind, that is formed when a set of nerve fibres is arranged into the type of structure that is required to facilitate the classification of external stimuli". According to Rosser, "cognition clearly relates again to Hayek's views of pattern formation in the mind in his psychological theory. Such pattern formation out of perceptions can be seen as another example of the spontaneous emergence of order in the complex system of the mind" (Rosser, 2010, p. 170).

Classification and reclassification are at the heart of the functioning of the mind. They are related to the main characteristics of human reasoning such as discrimination, abstraction, generalization, consciousness, transfer, or conceptual thought (Hayek, 1952a, 147).

They also help to understand why Hayek often emphasized that abstraction precedes perception, inasmuch as to perceive is to classify. In other words, the sensory order is organized along a pyramidal system of categorization of increasing degrees of abstraction so

[15] "... a negative feedback system reverses a change in input and responds to a perturbation in the opposite direction" (Anufriev et al., 2013, p. 666).
[16] Emergence is a property of complex systems. See e.g. Rosser (1999) and Koppl (2009).

that our conscious experience is the product of "specification by superimposition" (Hayek, 1969 in Hayek, 1978, 48).

Let us now investigate how classification and reclassification operate within the structure of the brain.

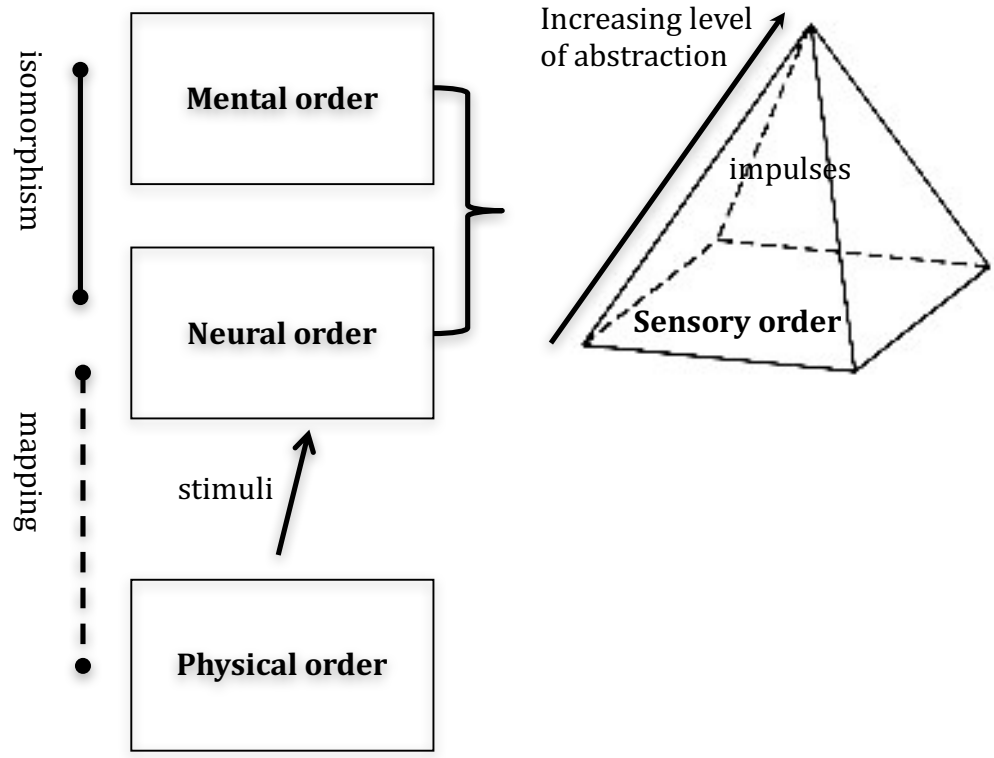

Figure 1. The cognitive complex system

c. The map(s) and the model

Hayek (1952a, 104) describes the organization of the nervous system as a network of "linkages", which are the mechanisms enabling "the formation of new connexions by the simultaneous occurrence of several afferent impulses." The linkages themselves are organized

into a map that can be conceived as the set of hierarchical systems of impulses which constitute the structural memory. The map nevertheless, is subject to "continuous although very gradual change" because "the relationships between various kinds of events in the external world, which the linkages will gradually produce in the higher nervous centres" change over time (ibid, 110).

Hayek's description of the hierarchical organization of the brain is very close to Bertalanffy's second principle of General System Theory, to wit, the 'principle of hierarchization' or the 'principle of progressive organization'. This principle states that "the properties and modes of action of the higher levels are not explainable by the summation of the properties and modes of action of *their components as studied only in isolation*." (Bertalanffy, 1932, 99; original emphasis)[17].

Hayek had something very similar in mind when he wrote:

> As any afferent impulse is passed on to higher levels, it will send out more and more branches which will potentially be capable of reinforcing or inhibiting an ever-increasing range of other impulses. This increasing ramification of every chain of impulses, as it ascends through successive relays to higher levels, will mean that at any moment the general excitatory state of the whole nervous system will depend less and less on the new stimuli currently received, and more and more on the continued course

[17] This has to be linked to the notion of emergence Hayek introduces in *The Theory of Complex Phenomena* (1964): The "emergence" of "new" patterns as a result of the increase in the number of elements between which simple relations exist, means that this larger structure will possess certain general or abstract features which will recur independently of the particular values of the individual data, so long as the general structure (as described, e.g., by an algebraic equation) is preserved. Such "whole", defined in terms of certain general properties of their structure, will constitute distinctive objects of explanation for a theory, even though such a theory may be merely a particular way of fitting together statements about the relations between individual elements" (Hayek, [1964] 1967, p. 26).

> of chains of impulses set up by stimuli which were received during some period of the past. (Hayek, 1952a, 112)

This organization as a pyramid of maps largely determines how individuals perceive (in a very simplified way) their environment. In particular, it guides them to discriminate between what can be considered as a stable or an unstable environment. Hayek (ibid, 114) suggests that this is rendered possible by the fact that "certain constellations of impulses mutually support each other, or that by a sort of circular process they will tend to re-evoke themselves rather than a different constellation corresponding to a different environment" (ibid). In other words, the maps provide a kind of reinforcement or positive feedback process between the sets of impulses that permit individuals to expect a stable environment (see figure 3). Note that this property is similar to the concept of re-entrance in neural Darwinism (see Edelman, 1987).

According to Hayek the map must be distinguished from what he calls the model. While the map is a mental matrix made of the "semi-permanent connexions representing not the environment of the moment but the kind of events which the organism has met during its whole past", the model "is formed at any moment by the active impulses" (ibid, 115). In a nutshell, it could be said that the maps constitute a multi-level system of potential impulses inherited from former generations while the model is their current realization, i.e. the path or trajectory that the impulses effectively take in the structural network formed by the maps in the course of an individual's personal life (see figure 2).

In compliance with the logic of classification and reclassification, the model is appraised and modified in terms of its expected consequences, by means of a negative feedback

mechanism[18]:

> The current sensory reports about what is happening will be checked against expectations, and the difference between the two will act as a further stimulus indicating the required corrections. The result of every step in the course of the actions will, as it were, be evaluated against the expected results, and any difference will serve as an indicator of the corrections required. (Hayek, 1952a, 95)

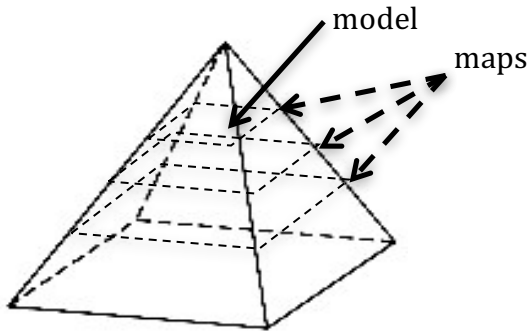

Figure 2. The maps and the model

To sum up, Hayek's conception of individual rules of action is based on a General System Theory approach *a la* Bertalanffy. The system of the mind is a complex one, and as such is non-deterministic[19]. Accordingly it is impossible to forecast its reaction to the changing external world because first, the mind provides only an interpretation, and second, the internal

[18] Hayek quotes N. Wiener (1948a, 1948b), W. S. McCulloch (1948) and W.R. Ashby (1947, 1948, 1949) in a footnote in Hayek (1952a, 95). However, both footnote and the index on p. 205 refer incorrectly to Ashley rather than Ashby, which is included in the bibliography p. 195. Again, Hayek uses the results of cybernetics.

[19] See e.g. Rosser (1999), Koppl (2009), and Kirman (2011).

connections inside the mind are not univocally determined (different stimuli can produce the same reaction[20], and the same stimuli can end in different reactions).

We next describe the second complex system which includes individual and social rules of conduct.

1.2 The system of rules of conduct

The system of rules of conduct described by Hayek is best illustrated by the famous formula 'the result of human action but not of human design'[21], which inevitably evokes Menger's ([1883] 1963, 146) organic approach to social phenomena such as institutions: "How can it be that institutions which serve the common welfare and are extremely significant for its development come into being without a common will directed toward establishing them?".

Hayek's analysis of the complex system of rules of conduct is found in his 'Notes on the Evolution of Systems of Rules of Conduct' (1967), which is a central part of his often debated theory of cultural evolution (see Festré and Garrouste, 2009). In this article, Hayek explains how individual rules of conduct followed by groups of individuals give rise to orders of actions which take place at the level of the whole group at a given time in the course of evolution. We show below that this process of selection of rules operates at two levels: selection of individual rules by individuals based on social imitation and conformity with the other individuals in the group, and blind natural selection of rules based on the efficiency of the orders of actions taken at the level of the group.

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[20] This property is similar to the notion of degeneracy in biology, i.e., the ability of elements that are structurally different to perform the same function or yield the same output.

[21] Published in French, *Les fondements philosophiques des sociétés économiques (textes de J. Rueff et essais rédigés en son honneur le 23 août 1966)* Claassen, E. M. (ed.) 1967 Payot : Paris, and in English as Hayek, F. A. 1967. *Studies in Philosophy, Politics and Economics*, Routledge & Kegan Paul: London (pp. 96-105).

In sum, the complex system of rules of conduct involves two distinct systems or levels of analysis: "the elements of any order" and the "resulting order" in general terms, or in the particular instance of Hayek's social theory, "the individuals" and "the group of individuals" (Hayek, 1967 in Hayek (1967), 67 and footnote 1). Hayek (1967, 67) indeed makes clear that: "The systems of rules of individual conduct and the order of actions which results from the individuals acting in accordance with them *are not the same thing*" (emphasis added)

The essence of his argument is that in a human society, as in an animal society, individuals observe common rules of conduct which depending on their life circumstances, will produce certain action rules. However, there is no one-to-one correspondence between the individual level rules and those that apply at the group or social level. In other words, the regularity of practices and rules of individual conduct, although it assists and favors the emergence of orders of actions which protect the individuals belonging to a same group, does not imply that individual rules are connected *via* a one-to-one relation to the order of the actions that result from them:

> It is the resulting overall order of actions but not the regularity of the actions of the separate individuals as such which is important for the preservation of the group; and a certain kind of overall order may in the same manner contribute to the survival of the members of the group whatever the particular rules of conduct of individuals are which bring it about. (Hayek, 1967 in Hayek (1967), 68)

Hayek comments at length on the reasons why these two systems differ from one another. For him, there are different kinds of relationships between individual rules and social rules of conduct: "it is at least conceivable that the same order of actions can be produced by different

sets of rules of individual conduct" (Hayek, 1967 in Hayek (1967), 68)[22]. Hayek notes also that there is no determinism between the order of actions and individual rules of conduct: "The same set of rules of individual conduct may in some circumstances bring about a certain order of actions, but not do so in different external circumstances" (Hayek, ibid).

Closer investigation reveals that these reasons boil down to enumeration of the properties of the notion of emergence. In philosophy, the notion of emergence is defined by three key properties: supervenience, irreducibility, and downward causation (Kim, 2006). The first property states that a dependence relation exists between the (macroscopic) emerging properties and the micro-properties of the system, such that systems with similar micro-properties have the same emergent properties. This is described also as upward causality. The principle of irreducibility implies that a complete account of the macro-properties of a system is not be possible at the micro-property level of the same system. It implies also that the higher level possesses novel properties that are beyond prediction and explanation. Finally, downward causality means that proper causal effects based on the system's macro-properties affect the micro-conditions of the system. This means that in the same way that the macro-properties cannot be reducible to the micro-conditions of the system, its micro-properties cannot be understood independent of the effect exerted on them by the emergent level.

The idea of downward and upward causation is described by Hayek as follows[23]:

[22] E.g. charity-giving as an order of actions can be produced by two different individual rules of conduct: impure and pure altruism (cf. Andreoni, 1990)

[23] Note that this is reminiscent of Menger's idea of mutual causation which is at the core of what in his *Untersuchung* he calls the "compositive method": "This holds true first of the analogy which is supposed to exist between the two groups of phenomena under discussion here with regard to the normal nature and the normal function of the whole being conditioned by the parts and of the parts by the whole. There is a view that the parts of a whole and the whole itself are mutually *cause* and *effect* simultaneously (that a *mutual causation* takes place), a view which has frequently taken root in the organic orientation of social research" (Menger [1883], 132-133).

> The individual with a particular structure and behaviour owes its existence in this form to a society of a particular structure, because only within such a society has it been advantageous to develop some of its peculiar characteristics, while the order of society in turn is a result of these regularities of conduct which the individuals have developed in society. (Hayek, 1967 in Hayek (1967), 76)

The idea of non-intentionality plays an important role in explaining why the level of the order of actions cannot be reducible to the level of individual rules of conduct. Hayek makes it clear that in using the term 'rule', he does not intend that "such a rule is 'known' to the individuals in any other sense than they normally act in accordance with it" (Hayek, 1967 in Hayek (1967), 67). Moreover, the order of rules does not derive from individual motives in a direct and trivial way:

> The immediate cause, the impulse which drives [individuals] to act, will be something affecting them only; and it is merely because in doing so they are restrained by rules that an overall order can results, while this consequence of observing these rules is wholly beyond their knowledge. (ibid p. 77)

In the same vein, Hayek wrote in 'Individualism: *True and False*':

> All the possible differences in men's moral attitudes amount to little, so far as their significance for social organization is concerned, compared with the fact that all man's mind can effectively comprehend are the facts of the narrow circle of which he is the center; that, whether he is completely selfish or the most perfect altruist, the human

needs for which he *can* effectively care are an almost negligible fraction of the needs, of all members of society. (Hayek, 1948, 14)

Hayek also stresses that the rule selection processes which occur at the two different levels also involve two different – cultural vs. natural – principles of selection: The genetic (and in a great measure the cultural) transmission of rules of conduct takes place from *individual* to *individual*, while what may be called the natural selection of rules will operate on the basis of the greater or lesser efficiency of the resulting order of the group" (Hayek, 1967 in Hayek (1967), 67; original emphasis).

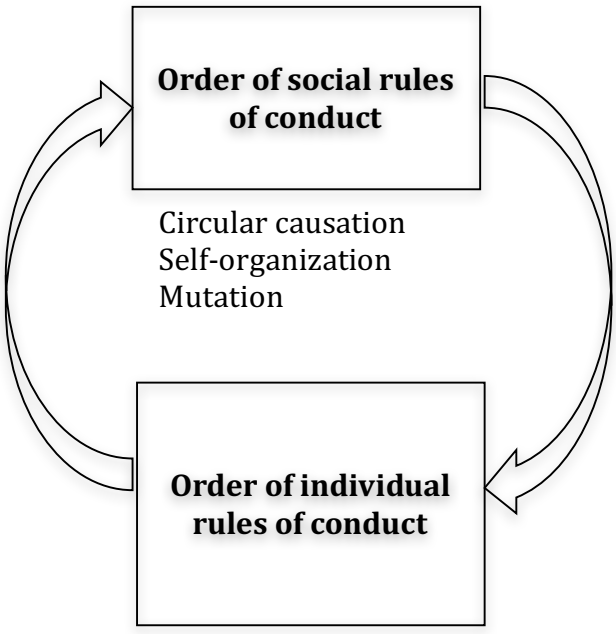


Figure 3. The complex system of rules of conduct

It follows that the two complex systems described here are not governed by exactly the same logic although both are spontaneous orders characterized by some indeterminacy. While the cognitive complex system can be interpreted in terms of Bertalanffy's General System Theory, the interplay between individual rules of conduct and the overall order of actions to which they give rise, is more compatible with the notion of emergence. An important distinction lies in the fact that the structure of the mind is hierarchic whereas it is not the case for the complex system of rules of conduct. This feature is systematically undermined in the literature[24] in favor of the tempting and often used mind-society analogy[25]. However, contrary to what most commentators suggest, Hayek is reluctant to use this metaphor as the following quote from his 'Notes on the Evolution of Systems of Rules of Conduct' (1967) makes clear:

> Such spontaneous orders as those of societies; although they will often produce results similar to those which could be produced by a brain are thus organized on principles different from those which govern the relations between a brain and the organism which it directs. Although the brain may be organized on principles similar to those on which a society is organized, society is not a brain and must not be represented as a sort of super-brain, because in it the acting parts and those between which the relations determining the structure are established are the same, and the ordering task is not deputized to any part in which a model is preformed. (Hayek, 1967 in Hayek (1967), p. 74)

Although both brain and society are complex systems which articulate different levels of orders, and therefore seem to be working according to similar principles, the logic defining

[24] See e.g. Butos and Koppl (1993).
[25] For instance, Colin Blakemore, a British neurologist, writes: "the brain struggling to understand the brain is society trying to explain itself" (from *Mechanics of the Mind*, 1977).

the relation between the brain and the physical body to which it refers differs from the one that governs the two-level rule-following behavior of the individual.

In the cognitive system, Hayek explains, the relations between the physical order, i.e., "the physical order of the external world or the physical stimuli" (Hayek, 1952a, 39), and the neural order involves elements which are of different nature although they are not disconnected (stimuli from the physical order are reflected into ontologically different objects called impulses in the neural order). Also, the connection between the neural order and the sensory order involves a multi-level mental processes hierarchy.

By contrast, in society, the acting parts, i.e. the individual rules of conduct and those between which the relations determining the structure are established, namely the order of actions, are the same; in other words, they are of the same nature. To be clear, the order of actions is not an interpretation of individual rules through pre-defined categories, even though as Hayek proposes that "the system of rules of [individual] action" is built up (…) on an interpretation of the external world" (Hayek, 1969 in Hayek, 1978, 43). Moreover, the interplay between rules of individual conduct and the social order of action involves no hierarchy. Hayek refers to the social order of actions interchangeably as a "single-stage", "polycentric[26]", or "non-hierarchic" order endowed with "self-organizing forces", and which "dispenses with the necessity of first communicating all the information on which its several elements act to a common centre and conceivably may make the use of more information possible than could be transmitted to, and digested by, a centre" (Hayek, 1967 in Hayek (1967), 74). In a nutshell, what Hayek rejects in the mind-society metaphor is above all, the mistakenly assumed necessity of the existence of a relation between a directing unit and the rest which would be 'executive' (see Birner, 1999, 59). He explains that the crucial difference between the mind

[26] Note that when Hayek uses the term "polycentric" he refers explicitly to Michael Polanyi's distinction between monocentric and polycentric orders[26] in his *The Logic of Liberty* (1951).

and self-organized structures such as single-stage orders involving direct interaction between the parts and the whole, is that it is a prerequisite for survival for the brain to deal with "representations of an effect to be expected" based on "patterns of actions" that have been selected *ex ante*, while single-stage orders such as the interplay between individual rules of actions and the order of actions which results from them can deal directly with "actual effects", the selection process of action rules having the 'desirable effects' that occur *ex post* (Hayek, 1967 in Hayek (1967), 73).

We highlight in section 2 that these differences are helpful for understanding how individuals form expectations with respect to their own knowledge as well as with respect to the consequences of their actions on others.

2. What kind of theory of expectations and prediction follow from Hayek's conception of human cognition and behavior?

2.1 The limits to prediction when dealing with complex systems

We have shown that the cognitive system and the system of rules of conduct are two complex systems which share some common features, in particular some properties of emergence in multi-level analysis and the related indeterminacy of 1) the exact relations between causes and effects in the cognitive system, and 2) the result of the selection processes occurring at both the individual and the social levels.

On the one hand, in relation to indeterminacy in complex systems, Hayek refers to both the Law of Requisite Variety proposed by Ashby (1956) and to Gödel's (1931) incompleteness theorems.

According to Ashby's (1956) law[27], regulation and control of a system are possible if and only if the system that undertakes to control and regulate this system is at least of the same variety. Applied to mind classification, this laws would mean:

> that any apparatus of classification would always has to possess a degree of complexity greater than any one of the different things which it classifies; and if this is correct it would follow that it is impossible that our brain should ever be able to produce a complete explanation (as distinguished from a mere explanation of the principle) of the particular ways in which it itself classifies external stimuli. (Hayek, 1964 in Hayek (1967), 49)

Hayek also refers to Gödel's incompleteness theorems[28]:

> The first incompleteness theorem states that in any consistent formal system *F* within which a certain amount of arithmetic can be carried out, there are statements of the language of *F* which can neither be proved nor disproved in *F*. According to the second incompleteness theorem, such a formal system cannot prove that the system itself is consistent (assuming it is indeed consistent). (Stanford Encyclopedia of Philosophy: http://plato.stanford.edu/entries/goedel-incompleteness/)

As Caldwell (2004, 248) recalls, Hayek's increased interest in complex systems can be traced back to the 1950s when he joined the Committee on Social Thought at the University of

[27] "If V_D [the variety *V* of a set *D* is the number of distinguishable elements it contains] is given and fixed, $V_D - V_R$ can be lessened only by a corresponding increase in V_R. Thus *the variety in the outcomes*, if minimal, *can be decreased further only by a corresponding increase in that of R*."…"This is the Law of Requisite Variety." (Ashby 1956, p. 207) This law allows to define the possibility of regulation and control of a system.

[28] See Hayek (1967), p. 62. The exact meaning of the supposed relationship between Gödel's theorems and the essential propositions in Hayek's theory of mind is subject to interpretation. For a thorough discussion, see van den Hauwe (2011) and Koppl (2010).

Chicago. This Committee held a seminar[29] which attracted many natural scientists from around the university. The manuscripts of his Hayek's two ongoing works, *TSO* (1952a) and his Essay on 'Scientism and the study of society' (Hayek, [1942-44] 1952b) were the major readings under discussion which prompted Hayek's interest in complex systems such as cybernetics, the system theory of Ludwig von Bertalanffy, von Neumann's theory of automata. It was during this period also that Hayek began to move away from his dichotomy between natural and social sciences[30] in order to adopt the classification provided by the philosopher of sciences Warren Weaver (1948), between "simple systems", and "disorganized" and '"organized complexity"[31]. Hayek leaves aside the intermediate category of "disorganized complexity" in order to concentrate on "organized complexity" which characterizes problems which "involve dealing with a *sizeable number of factors which are interrelated into an organic whole*." (Weaver, 1948, 537; original emphasis). For Hayek, dealing with complex systems inevitably involved some limits to prediction. The main arguments can be found in two articles - 'Degree of explanation' (Hayek, 1955 in Hayek (1967)) and 'The Theory of complex phenomena' (Hayek, 1964 in Hayek (1967)).

First, he explains that theories of complex systems do not constitute closed self-contained systems:

> A theory will always define only a kind (or a class) of patterns, and the particular manifestation of the pattern to be expected will depend on the particular circumstances (the 'initial and marginal conditions' to which (…) we shall refer as 'data'). How much in fact we shall be able to predict will depend on how many of those data we can

[29] We know from the archives that Hayek later considered this seminar as "one of the greatest experiences in [his] life." (Hayek 1983, p. 184).

[30] This is the dichotomy Hayek refers to in particular in his essay on "Scientism and the study of society" (Hayek 1952b).

[31] Weaver (1948, 38-40) defines "simple problems" as two-variable problems that characterized the physical sciences before 1900. Complex problems fall into two categories: disorganized vs. organized complexity. 'Disorganized complexity' defines "problems in which the number of variables is very large, and (…) in which each of the many variables has a behavior which is individually erratic, or perhaps totally unknown (…) and "to which statistical methods hold the key".

ascertain. (Hayek, 1964 in Hayek (1967), 56)

The more complex the system the less we are able to predict particular phenomena. Compared to the natural sciences, the phenomena of life, mind, and society are more complex. In order to define the degree of complexity of phenomena, Hayek writes that "the minimum number of elements of which an instance of the pattern must consist in order to exhibit all the characteristics attributes of the class of patterns in question appears to provide a unambiguous criterion" (ibid). This definition of the degree of explanation refers explicitly to Ashby's Law of Requisite Variety. Consequently, we must content ourselves with explanations "of the principle of the thing", and resist the temptation to control: "Such activities in which we are guided by a knowledge merely of the principle of the thing should be better described by the term *cultivation* than by the familiar term 'control'" (Hayek, 1955 in Hayek (1967), 19).

Hayek points also to the consequences in terms of Popper's refutation criterion. In Hayek's view, it seems to be a decreasing degree of falsifiability, as the advances of the sciences penetrates further and further into more complex phenomena: "(…) the more we move into the realm of the very complex, the more our knowledge is likely to be of the principle only, of the significant outline rather than of the detail. (…) only the theoretical system as a whole but no longer in part can be really falsified" (Hayek, 1964 in Hayek (1967), 18-20).

Finally, concerning the indeterminacy of social structures related to the two levels of selection of rules of conduct, Hayek refers to "conjectural history" as adequate to describe (social) structures or events such as "the existence of life on earth" which "are concerned with those factors in a sequence of events which are in principle repeatable, though in fact they may have occurred once" (Hayek, 1967 in Hayek (1967), 75). The indeterminacy of the result of the selection processes is due in particular to the manifold influences occurring at both the cognitive and the social levels:

> The concrete individual actions will always be the joint effect of internal impulses, such as hunger, the particular external events acting upon the individual (including the actions of members of the group), and the rules applicable to the situation thus determined. (Hayek, 1967 in Hayek (1967), 69)

In section 2.2 we describe how the cognitive level consists of impulses and individual rules of conduct, while the social level includes social learning and imitation as well as traditions that characterize social interactions.

We have shown also that the two complex systems display some differences in terms of their respective inner organization, the cognitive system being organized according to hierarchical principles while the system of rules of conduct is characterized by self-organized principles resulting from two levels of selection at the individual and the group/social level. In the *Constitution of Liberty* (1960), Hayek re-affirms the peculiarity of the system of rules of conduct, referring again to Michaël Polanyi's notion of "polycentric order":

> It is what M. Polanyi has called the spontaneous formation of a 'polycentric order': 'When order is achieved among human beings by allowing them to interact with each other on their own initiative—subject only to the laws which uniformly apply to all of them—we have a system of spontaneous order in society. We may then say that the efforts of these individuals are co-ordinated by exercising their individual initiative and that this self-co-ordination justifies this liberty on public grounds.—The actions of such individuals are said to be free, for they are not determined by any *specific* command, whether of a superior or a public authority; the compulsion to which they

> are subject is impersonal and general'. (Polanyi, 1951, 159 quoted by Hayek, 1960, 165)

Recall that our hypothesis is that the interactions between the two systems are important in order satisfactorily to grasp Hayek's view of expectations and predictions. Let us examine this perspective more closely.

2.2 The interactions between the two complex systems and the mitigating factors regarding the problem of expectations

a. The interactions between the two complex systems

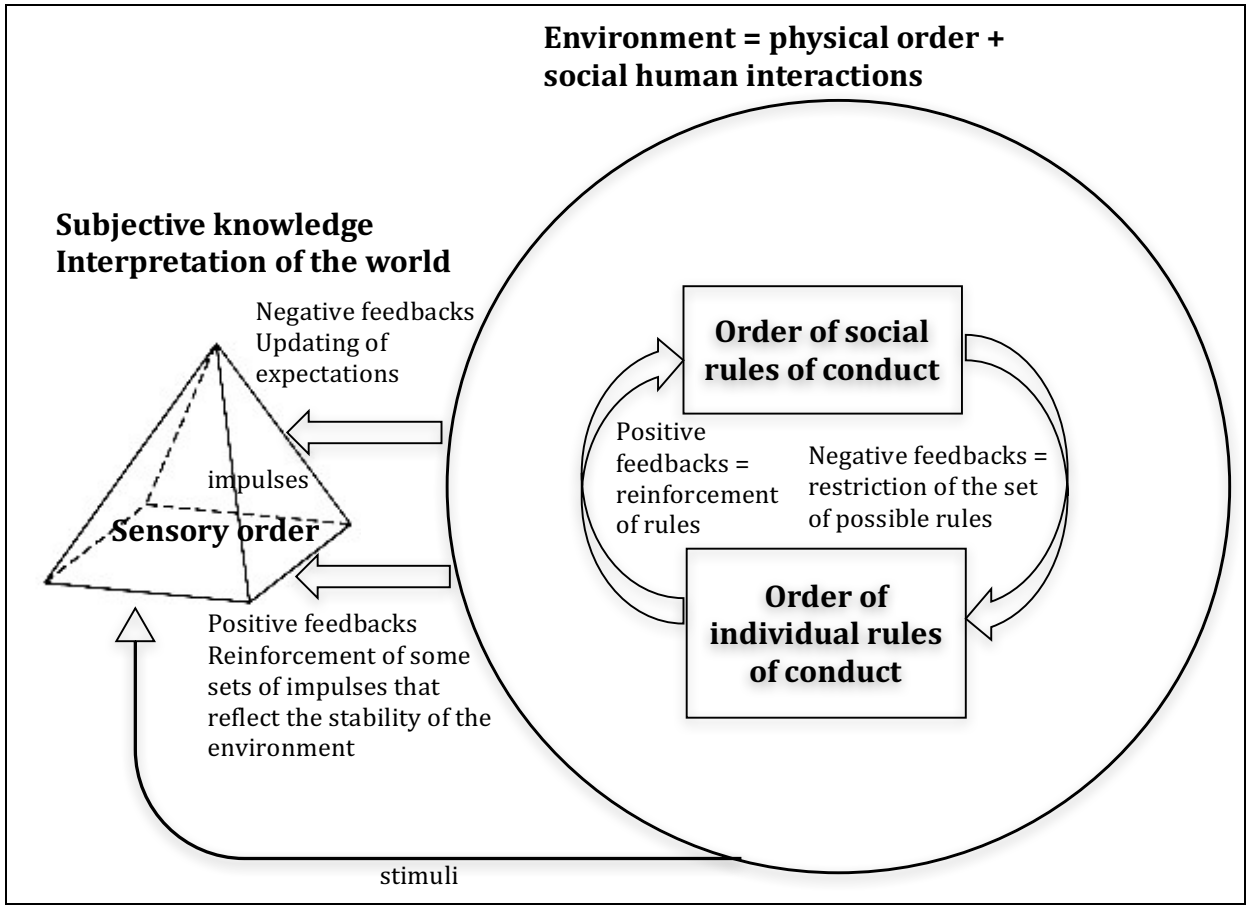
Figures 3 is a schematic representation of the interactions between the two complex systems. In particular it shows that both systems are related to the external environment, although in different ways. On the one hand, as already explained, the cognitive system is connected to the physical world through a mapping relation and *via* external stimuli. On the other hand, the system of rules of conduct involves two levels of analysis which allow more explicit accounting for the role of social interactions. The two systems obviously are related. According to Marsh (2013, 198), Hayek stands apart from classical Cartesian internalism by developing a conception of extended cognition in which the operation of the cognizer's mental states must be supplemented by an appeal to external considerations in particular social interactions, in order to evolve over time.

Hayek wrote in the *Constitution of Liberty* (1960):

> The whole conception of man already endowed with a mind capable of conceiving civilization setting out to create it is fundamentally false. Man did not simply impose upon the world a pattern created by his mind. His mind is itself a system that

constantly changes as a result of his endeavor to adapt himself to his surroundings. (Hayek, 1960, 23)

Figure 4 depicts the interaction between the two complex systems via feedbacks from the environment towards the brain/mind. It is possible to distinguish positive feedbacks[32] which reflect the stability of the environment through the reinforcement of impulses (i.e. a reinforcement of the "map" as discussed in section 1.1.) from the negative feedbacks resulting from the updating of expectations when current realizations differ from the expected results of an action[33].



[32] "A positive feedback system reinforces a change in input by responding to a perturbation in the same direction" (Anufriev et al., 2013, p. 666).

[33] This has to be linked to the idea that "in economic markets in general both types of feedback will play a role. On the whole however, negative feedback is usually associated with supply driven commodity markets and positive feedback with demand driven speculative asset markets" (Anufriev et al., 2013, p. 667).

Figure 4. The interactions between the cognitive system and the system of rules of conduct

Needless to say, such a conception of cognition can hardly be reconciled with the common view associated with the assumption of rational expectations which supposes homogeneous individual agents who benefit from equally distributed, unambiguous, codified, and complete information, and who, on average, do not make systematically biased expectations errors since they can exploit all the relevant information in order to make economic choices. In other words, according to this assumption, agents do have model-consistent expectations of a unique and stable model.

For Hayek, the cognitive system is the result of a historical process, which is partly innate and partly acquired through social learning. This implies that each individual has his own 'model' or representation of the environment in which he lives.

Already in his 1937 article on 'Economics and knowledge' Hayek expressed his dissatisfaction with the notion of perfect foresight conveyed by general equilibrium theory, which according to him, is tautological: "Correct foresight is not (…) a precondition which must exist in order that equilibrium may be arrived at. It is rather the defining characteristic of a state of equilibrium" (Hayek, 1937 in Hayek, 1948, 45).

He also made it quite clear that this notion was inappropriate to deal with social interactions since it implicitly assumes a single representative agent:

> The concept of equilibrium itself and the methods which we employ in pure analysis have a clear meaning only when confined to the analysis of the action of a single person and that we are really passing into a different sphere and silently introducing a

> new element of altogether different character when we apply it to the explanation of the interactions of a number of different individuals. (ibid, 35)

He pointed also to its inability to deal with the problem of time:

> Since equilibrium is a relationship between actions, and since the actions of one person must necessarily take place successively in time, it is obvious that the passage of time is essential to give the concept of equilibrium any meaning. This deserves mention, since many economists appear to have been unable to find a place for time in equilibrium analysis and consequently have suggested that equilibrium must be conceived as timeless. This seems to me to be a meaningless statement. (ibid, 36-37)

In his 1945 article entitled 'The use of knowledge in society', Hayek refers to "the knowledge of the particular circumstances of time and space" (Hayek, 1945 in Hayek, 1948, 80) as a kind of local or tacit knowledge, which does not have the properties of scientific knowledge to be general, unambiguous, codifiable, articulable, and therefore easily available and transferable to the whole society.

Hayek's writings on expectations have a common strand which at first sight might seem at odds with the way he conceives human cognition and behavior. In all the versions of his business cycle theory as well as in his articles on knowledge, Hayek refers to the existence of a tendency towards equilibrium. He re-affirms the existence of this tendency in his 1937 article, and assigns to expectations a key role in the process:

> a tendency toward equilibrium (…) can hardly means anything but that, under certain conditions, the knowledge and intentions of the different members of society are

> supposed to come more and more into agreement or, to put the same thing in less general and less exact but more concrete terms, that the expectations of the people and particularly of the entrepreneurs will become more and more correct. (Hayek, 1937 in Hayek, 1948, 45)

As the above quote suggests, and as we develop below, Hayek exploits several arguments in order to show that despite the evolutionary and non-deterministic character of both the cognitive and the two level-rule complex systems, there are mitigating factors that facilitate inter-individual coordination, and therefore, the convergence of expectations.

b. The mitigating factors

The first argument Hayek uses to explain why a process of convergence of expectations might occur is that human beings share common perceptions structures, and in particular, a neural property which means that the brain is structured along a principle of classification through an increasing degree of abstraction. For instance, he writes in *TSO* that:

> It would, of course, not be possible to discuss the phenomenal world with other people if they did not perceive this world in terms of the same, or at least of a very similar, order of qualities as we do. This means that the conscious mind of other people classifies stimuli in a manner similar to that in which our own mind does so, and that the different sensory qualities are for them related to each other in a manner which is similar to that which we know. In other words, although the system of sensory qualities is 'subjective' in the sense of belonging to the perceiving subject as distinguished from 'objective' (belonging to the perceived objects) - a distinction which is the same as that between the phenomenal and the physical order - it is yet

> inter-personal and not (or at least not entirely) peculiar to the individual. (Hayek, 1952a, 23)

In other words, inter-subjectivity is also rendered possible through the idea of mind-reading, i.e., the possibility to read the minds of others, or in Max Weber's words, to understand (in German: *verstehen*) it rather than explain (resp. *erklären*) it.

The second argument relates to human attentional capabilities[34]. It is interesting here that although Hayek argues repeatedly that "it is impossible that our brain should ever be able to produce a complete explanation (as distinguished from a mere explanation of the principle) of the particular ways in which it itself classifies external stimuli" or that "to 'explain' our own knowledge would require that we should know more than we actually do" (Hayek, 1952b, 47), he nevertheless considers that attention can give access to consciousness. More precisely, for Hayek consciousness is nothing else *in natura* than a classification system which is characterized by being "associated with the highest degree of generality of classification or evaluation" (Hayek, 1952a, p. 137). In addition, one criterion of consciousness is its unity, i.e., "a close connexion between all conscious events" (ibid, p. 136) which contrasts with unconsciousness, which occurs at different backward strata of decreasing abstraction, and therefore is characterized by its diversity. Thus, Hayek sees attention as differing only slightly from consciousness in being concerned mainly with events which are in some sense expected or anticipated: it is a "characteristic of attention that it has these effects" of greater discrimination "only with regards to events which are in some sense expected or anticipated" (Hayek, 1952a, 139). Another characteristic of attention is that it permits to highlight some of the patterns involved in the "model" directing behavior, and therefore to become more aware of the resulting mental events (ibid, 140). Finally, and most importantly in the context of the

[34] See Festré and Garrouste (2015) for more details.

problems of diffusion of tacit knowledge and inter-subjective coordination, human attentional aptitudes to focus on special events and trace back the process of abstraction that gave rise to them provide "the condition for the individual to participate in a social or conventional representation of the world which he shares with his fellows" (Hayek, 1952a, 142).

The third argument concerns the role of social norms or traditions for the cultural transmission of rules of conduct, and the related idea that individuals are reluctant to violate norms. For Hayek, the cultural transmission of rules of conduct involves learning through social imitation. In compliance with his view of the functioning of the brain, learning is conceived as preceding reason, insight, and understanding. Therefore, it is the only way to become wise, rational, and good in some sense (Hayek, 1988, 21). Let us now investigate the social forces and motives underlying such social imitation. Imitation of some members of the groups by others can be explained by "the order of dominance of the individuals within the group", namely the relative distribution between young individuals who are attached to particular adult members of the group from which they learn, and "dominant old individuals who are firmly set in their ways and not likely to change their habits, but whose position is such that if they do acquire new practices, they "are more likely to be imitated than to be expelled from the group" (Hayek, 1967 in Hayek (1967), 79). Social imitation also is facilitated by deep-rooted emotions such as "fear of retribution" (ibid) in the case of transgression of the norms of behavior. The desire for social approval and motivation for rule-observing behavior is deeply rooted in human beings, and has little relation to their being inherently subject to conformism or fascinated by power. It is interesting that Hayek

emphasizes that fear of retribution should be interpreted as "fear of the unknown" (ibid) whose avoidance increases the predictability of the world[35]:

> The knowledge of some regularities of the environment (…) create a preference for those kinds of conduct which produce a confident expectations of certain consequences (…) This establishes a sort of connection between the knowledge that rules exist in the objective world (…) and therefore also the belief that events follow rules and the feeling that one 'ought' to observe rules in one's conduct. (ibid, p. 79).

Finally, rule following behavior is strongly related to the structure of the brain and to how people learn. Since the only way to gain access to knowledge is to follow rules since the brain creates relations between stimuli and patterns of action, it is not surprising that this behavior is preponderant.

The fourth argument relates to what Hayek in the *Constitution of Liberty* (Hayek, 1960, 25) calls "knowledge of society". This kind of knowledge is derived from Michaël Polanyi's concept of tacit knowledge (Polanyi, 1951). Similar to common perception abilities, knowledge of society overcomes the limit of strict subjectivism by creating a space for a relatively autonomous objective reference. Alternatively, knowledge of society can be seen as a positive externality from all the particular individual knowledge stemming from social interactions (Arena and Festré, 2006). Fleetwood (1997, 170) qualifies this interpretation, noting that by drawing upon this kind of collective knowledge, "agents avail themselves of

[35] In passing, this interpretation precludes the argument that norm obedience imposed by sanction is subject to the 'second-order free-rider problem' (who punishes the punisher who does not sanction deviant behavior?), since the fear of punishment is sufficient to ensure observance of the rules (see Festré and Garrouste 2009, 271).

the collective wisdom of an evolving society, and are thereby enabled to initiate socioeconomic activity, although they can never know or articulate this collective wisdom".

3. Concluding remarks: Open minds in an open society

Our investigation leads us to conclude that Hayek's conception of mind and society cannot be reconciled with the dominant rational expectations assumption in economic theory which supposes model-consistency, i.e., a stable environment in which people are able to read the environment in which they live directly, apart from an error term which however does not alter the structure of the model. Boettke et al. (2013) encapsulate Hayek's knowledge problem as "error is obvious, coordination is the puzzle".

According to our reading of Hayek, the difficulty involved for individuals to form correct expectations is due to the interplay between two evolutionary complex systems. On the one hand, the complexity of the cognitive system whose structure is marked by hierarchically, abstract orders of classifications of impulses inside the brain, implies that the real world is perceived through a distorting and continuously changing and subjective distorting mirror - a result of the combination of the map and the model. Therefore, perceptions are adaptive rather than strictly veridical and specific to an individual even though as we have emphasized, there are mitigating factors such as people's common perception and attention abilities which allow inter-individual coordination. On the other hand, the complexity of the system of rules is the result of the blind selection process which takes place at the social level and is non-determinist, and neither necessarily nor directly related to individual motives or intentions.

In a short paper "Two types of minds", Hayek (1978) distinguishes between two kinds of minds: "the master of his subject" vs. the "puzzlers" or "muddlers". He describes himself as a puzzler who makes use of "wordless thought". To paraphrase Leijonhufvud (1993, 2), we

believe the main justification for Hayek's conceiving both the mind and the society in terms of orders of complexity is to provide an answer to the puzzling question of how seemingly simple people can cope with incredibly complex situations while the tendency among economists after the 1950s is to describe the behavior of incredibly smart people in unbelievably simple structures.

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