# Hayek's approach to cognitive and social order

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# Hayek's Approach to Cognitive and Social Order

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**Abstract**

The human being can be regarded as a product of evolution. She has prevailed in the evolutionary process because of her ability to create and to use knowledge. The creation and the use of knowledge depend on the cognitive and on the social order. Both types of order are interdependent. Hayek sought to analyze the principles of both types of order. In particular, he based his analysis on three research disciplines: Evolutionary Epistemology, Cognitive Psychology, and Systems Theory. In this article, we recapitulate and revise his respective analysis. Hayek's approach thus appears as particularly sustainable and powerful.

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## 1 Introduction

According to Hayek, our social interaction is mainly characterized by how we create and use knowledge. Basically, knowledge is something that is created by our nervous systems. Each nervous system is a separate entity. It follows its own purposes and uses its own 'language'. Therefore, knowledge cannot be directly transmitted. To transmit parts of our knowledge, we need some code. A code represents a set of rules which describes correspondences between two different languages; where 'language' is conceived in a broad sense. Such a set of rules creates order. Hayek describes 'order' as "a state of affairs in which a multiplicity of elements of various kinds are so related to each other that we may learn from our acquaintance with some spatial or temporal part of the whole to form correct expectations concerning the rest, ... (Hayek, 1973, p. 36)." Thus, social order allows any member of a respective group to form correct expectations about the interaction with others. The specific structure of a social order depends on the individual knowledge of each member. The individual knowledge of a member depends on the order of his nervous system.

Hayek considers our nervous system as an evolutionary product. In the process of evolution, it has developed in interaction with its specific environment. Major parts of this environment have always been social groups. Major tasks of the nervous system have been to carry out cognitive functions. Hence, it depends on the process of (social) evolution how we perceive, classify, memorize, think, reason, decide, and speak; how we create and use knowledge. In sum, there appear various interdependencies between the cognitive and the social order. To better understand these interdependencies, it seems indispensable to follow an interdisciplinary approach. In our field, issues of economics, sociology, psychology, and biology overlap. In the following, we are going to look at how Hayek encountered this urgent scientific challenge.

# 2 Hayek on Cognition, Social Interaction, and Science

## 2.1 The Cognitive Order

Hayek starts his analysis of the cognitive order from the following basic question of psychology: Why do we sometimes perceive similar physical stimuli as different, or different physical stimuli as similar? - Discrepancies between the physical object and our perception become particularly conspicuous with respect to configurations. Within such configuration, we may perceive two similar shapes as different, or two different tones as similar. Hence, our nervous system seems to follow some particular rules. These rules do not perfectly correspond to the structure of the physical object.

In his analysis of cognition, Hayek distinguishes three specific worlds:

1. The external physical world: It contains our environment and its stimuli on us.

2. The nervous system: This is the world in which we receive, transmit, and transform the stimuli.

3. The mental world: Here, we organize our thoughts and behavior.

Hayek states that the orders of world 3 and 2 are isomorphous, but not those of the world 3 and 1. Thus, discrepancies between the physical object and our perception can arise. Hayek defines isomorphism as "a structural correspondence between systems of related elements in which the relations connecting these elements possess the same formal properties (Hayek, 1952b, p. 38)." He points out that this definition does not refer to real spaces. Two distinct elements may therefore occur on identical positions. A system consists of its elements and their relationships. The whole may be more than the mere sum of its parts.

Hayek thus conceives the mind as the order within world 3, which relates to world 2 and to 1, in distinctive manners. He seeks to answer the following two questions: How do the relationships between the mind, the nervous system, and the external physical objects arise? How do these relationships work?[1]

Hayek examines the nervous system as a part of our organism. He considers the organism as a product of evolution. In order to prevail, any organism has to adapt to its environment. The process of adaptation is characterized by two components: a phylogenetic and a ontogenetic one. In the phylogenetic process, the organism seeks to prevail as a member of its species. Its behavior is based on its genetic structure. Greater changes of this structure can only be reached by reproduction. Normally, an organism can only reproduce by the combination with another one of the same species. In the ontogenetic process, the organism seeks to prevail as an individual. It guides its behavior along individual needs. The behavior can be changed, at any time. Nonetheless, it is not independent of the organism's genetic structure.

The external world of an organism changes over time. The organism is thus confronted with various types of stimuli. Hayek describes the basic principle of its response, as follows: In the phylogenetic and in the ontogenetic process, the organism learns to construct a system of differentiations between stimuli. Each stimulus is classified; which means that it is assigned to a certain place in an internal order. The place depends on the significance that the stimulus seems to have for the organism. Classification is thus a process in which stimuli are discriminated, transformed and grouped. Stimuli belong to the same class, if they provoke the same response. The instrument by which the organism performs its classification is the nervous system. Hence,

[1] See Hayek (1952b), chapters 1 and 2.

Hayek finds two major reasons why the order of world 2 is not isomorphous to world 1: First, the capacity of the organism to adapt is limited. Second, the nervous system classifys the stimuli according to its own criteria, based on the needs of the species and of the individual organism.[2]

The nervous system is guided by the mind. The mind adapts the experiences to the organism's needs. It compares and evaluates the substances and the structures of the experiences. Thus, the elements may be reclassified. The classes represent different levels of abstraction; they may create linkages with each other. While the classes are a priori to the experience, the linkages are a posteriori. The mind is able to treat a substance, only if it fits to at least one of the classes. It always reclassifys an element with respect to the other existing substances and the linkages between their classes. Hayek thus considers the mind as a creator of order. It orders experiences in an active, tentative, selective, cumulative, and abstract manner.[3]

The mind seeks to guide the nervous system such that the whole organism can prevail in its environment. Therefore, any mental order is oriented towards the action of the organism; the mind creates dispositions to act. To make an action meaningful, the mind has to generate expectations. The expectations represent provisional hypotheses. New and contradicting experiences lead to adaptations, to reclassifications. The reclassifications are determined by the former experience and the current needs of the organism. For this reason, the order of world 3 is not isomorphous to world 1.

An expectation will be the better, the more the relevant patterns of the mental order equal the patterns of the external physical object. Hayek describes the degree of equality between the two patterns by the term 'understanding (verstehen)'. The mind seeks to understand its environment. It searches for similar patterns under various circumstances. However, the mental process is only partly conscious. Our intellect can modify the circumstances only to the degree to which the respective mental process is conscious. Hayek concludes that our intellect can never fully control (the consequences of) our actions.[4]

## 2.2 The Social Order

For a human being, key objects of world 3 are normally other human beings. Thus, human beings meet each other as physical objects. One nervous system perceives the action of another. One mind seeks to understand another.

[2]See Hayek (1952b); Bouillon (1991).
[3]See Hayek (1952b, 1979b).
[4]See Hayek (1952b, 1967a, 1982).

To adapt their actions to one another, the human beings need to develop common rules. They need to learn to understand the meaning of actions.

According to Hayek, a human being starts each learning process by forming a provisional hypothesis. Then, she compares this hypothesis with her respective perception. She abstracts the patterns of the perceived actions. The fitting parts of the patterns are adopted; the unfitting parts are rejected. The human being consolidates the new patterns by a modified imitation of the perceived behavior. Much of this general learning process happens unconsciously. Hayek states that a human being will be the more able to understand another, the more both share in their phylogenetic and in their ontogenetic developments.

As a major instance for the principles of human understanding, Hayek describes the ability of small children to learn a language. A language is a key instrument for a human being to set stimuli to others, to exchange information. She gets the conditions to learn a language in the phylogenetic process; she can actually learn it in an ontogenetic process. In the life-time of a human being, the conditions change somewhat. A small child perceives the phonems, morphems, words, and sentences from other human beings. She abstracts the patterns of the stimuli; she imitates them in a modified way. Thus, her own language adapts to the given rules, from the more general to the more specific ones. Most of this concrete learning process happens unconsciously. As a result, a human being will often be able to correctly use the grammar of her own language, although she is not able to explicitly explain this grammar.[5]

To stabilize exchange, human beings join together in groups. A group is characterized by specific rules and specific purposes. A group member mainly learns the specific rules in the process of exchange with other members. He adapts his action patterns to the norms of the group. At the same time, his related actions feed back to the norms of the group. A member will hardly be aware of all the rules and purposes which characterize his group. He simply seeks to participate in an order, in the best way he can. The causes and the effects of this order may exceed his intellect.

Hayek distinguishes two general types of order: First, the artificial order: This type is exogenous; it follows particular purposes and thus becomes concrete, simple, and certralized. Second, the spontaneous order: This type is endogenous; it follows general purposes and thus becomes abstract, complex, and decentralized. According to Hayek, the two types tend to generate different effects, mainly because the second allows each participant to integrate more of his particular knowledge. The spontaneous order is able to

[5]See Hayek (1967b).

coordinate more varying action patterns. It coordinates interaction in a less direct way. It also allows each participant to make use of the others' knowledge. Thus, each can use much more knowledge than he possesses by himself. Hayek explains this difference between the artificial and the spontaneous order by the 'fact of our irremediable ignorance': Particular knowledge can hardly be transferred, in a conscious, direct, and comprehensive manner. No central entity can gather all particular knowledge and deliberately channel this knowledge into specific and consistent rules.[6]

A group as a whole is characterized by a specific order. The order bases on a system of rules of action. The functional form between the two also depends on the external conditions. Thus, it may be possible that different systems of rules produce similar orders, or that similar systems of rules produce different orders. A specific order does hardly arise in the way that the group members intend. They even may be unaware of the really existing order. What matters for each member is whether he can follow certain purposes. The purposes can only be reached by the group as a whole. Hence, the preservation of the group does rather depend on the overall order than on specific rules of action.[7]

In the process of instituional evolution, groups need to adapt to changing environments. According to Hayek, a system of rules of action can only survive, if it makes the group as a whole more successful than others. Groups compete for membership. If a member can better reach his own purposes in a different group, then he will withdraw. Nonetheless, to join a different group also means that he must learn new rules and thus give up old action patterns. The adaptation takes place on various levels of consciousness. The institutional evolution thus selects between different specific orders. The objects of such selections are social groups and not individuals.[8]

A human being may participate in several groups; the groups may differ in size and in order. Moreover, each group is characterized by specific rules and purposes. But, the rules and purposes of different groups may stand in conflict with one another. Not any combination of memberships is possible. As a group member, a human being adapts her behavior to the specific rules. The adaptation may happen consciously or unconsciously. A conscious adaptation impresses on the human being's intellect; an unconscious one on her instincts. Thus, a human being may become part of several traditions. The traditions may change in the process of institutional evolution.

In the history of institutional evolution, the human being started as a

[6]See Hayek (1973), ch. 2.
[7]See Hayek (1967c).
[8]See Hayek (1973), ch. 1.

member of a tribe. Such a tribe was a small group in which the members stood in face-to-face relations with each other. The dominant norms within such a group were altruism and solidarity. The individual actions were coordinated by an artificial order. In later stages of the history, new types of groups appeared. These types were rather characterized by: anonymity, self-interest, formal contracts, and a spontaneous order. The new types often conflicted with a human being's instincts. Hence, human beings initially reacted with resistance. However, the new types mostly prevailed because they allowed their members to be more successful. They could integrate more different actions and more different knowledge. As Hayek remarks, the human beings' intellects were rather formed by the institutional evolution than the other way round.[9]

## 2.3 Tasks of the Empirical Sciences

The main task of all empirical sciences is to describe and explain the world. However, it appears to be unclear how the world should be conceived. Hayek divides between three types of worlds: the external physical world, the nervous system, and the mental world. The three worlds interact with each other; they all participate in an evolutionary process. But, world 2 and 3 do not need to be isomorphous to world 1. According to Hayek, the fact of the basic heteromorphism should guide the scientific work. All sciences get the task to revise the classifications of our mind from the ordinary experiences. Very often, things are not what they simply seem to be. The sciences should help our mind to classify any experience as a particular instance of a general rule. Nevertheless, the objectives and methods of the natural sciences need to be clearly distinct from those of the social sciences.

In Hayek's normative conception, the natural sciences seek to adapt the classifications of our minds to the patterns of the external physical world. World 1 is given as the primary object. The natural sciences thus deal with 'objective' data, only. They try to describe and explain world 1 as it really is. In order to allow our minds to adapt to the patterns of world 1, they develop instruments and languages which extend the capacities of our nervous system. Thus, our mind can make experiences which do not belong to world 2, by itself. The systematic testing of our experiences becomes independent of the particular patterns of world 2. Hence, the natural sciences neglect particular products of the human mind, such as value judgements or emotional connections.[10]

[9] See Hayek (1976, 1983); Hayek (1988), ch. 1.
[10] See Hayek (1952a), part 1, ch. 2.

The social sciences deal with the human being and her relations to other human beings or to things. The central feature of the human being in this context is that she appears as being able to choose. Hence, the course of her relations seems to be open. What a human being chooses, depends on her mental order. The mental order also contains opinions. Such opinions may be false in the sense that their patterns do not correspond to given respective patterns of world 1. Nevertheless, they can determine the human being's choice, and thus have real effects in world 1. Things may become what she thinks they are. Hence, the social sciences deal with both: 'objective' and 'subjective' data.

A social scientist may be able to explain a human being's relations to the degree that he shares identical structures with her mind. The structures of the mind are formed in the phylogenetic and in the ontogenetic process. Therefore, a precondition for the social sciences is that the scientist and his object belong to the same species. Moreover, the explanations can be the better, the more identical the patterns of the experiences are that both have made. One major tool to adapt the patterns of the experiences is the human language. Nevertheless, our concrete knowledge about human beings and their relations must remain limited. One major reason is that many of our choices happen unconsciously. This holds for the scientist as much as for his object. Social actions thus will never base on a consistent and coherent body of knowledge. However, we usually can observe some order in social interactions. According to Hayek, the central task of the social sciences becomes to explain the principles of a social order. The central question is: How can individual actions, based on dispersed and imperfect knowledge, lead to consistent social results?[11]

Typically, economists describe and explain social results by an equilibrium concept. In the classical concept, the individuals have constant preferences and all the relevant knowledge. Hayek regards these assumptions as totally unrealistic. The scientific problem thus becomes one of mere logic. In the real world, the individuals have imperfect knowledge; relevant conditions change. Nevertheless, each individual forms specific expectations about her social environment. She plans her social action. In the social interaction, the individual expectations and plans meet each other. It can be seen whether they conform or conflict. Hayek distinguishes two sources of conflicts: First, endogenous disturbances: They arise from the preferences and knowledge of the involved individuals. Second, exogenous disturbances: They arise from the specific environment of the social interaction. Anyway, conflicts will lead to revisions of the expectations and plans. Thus, the description

[11] See Hayek (1952a), part 1, ch. 3.

and explanation of real social interaction requires a dynamic concept. For Hayek, the revelant questions are: Does there exist a tendency towards an equilibrium in which the relevant expectations and plans can be fulfilled? Why does there (not)?[12]

According to Hayek, any real problem in the social sciences arises due to the fact of evolution. In the evolutionary process, knowledge changes in a dispersed, spontaneous manner. In a spontaneous order, the knowledge tends to become more complex. Now, the central question for the social scientist is how to deal with the rising complexity. Hayek states that the scope for statistics is quite limited. Statistics deal with aggregates. These aggregates abstract from smaller, individual changes. A statistician uses to justify this abstraction by the 'law of large numbers'. However, Hayek believes that this law does not apply to the evolution of knowledge. The spontaneous order induces systematic and not unsystematic changes. Therefore, the best a statistician can reach is a correct description and explanation of some general social pattern.[13]

Efforts to describe and explain the world should not be made for their own specific purposes. Scientists should seek to contribute to a 'better' social order. In 'modern' societies, a central role to improve the social order is assigned to the political system. However, Hayek finds many strong inherent reasons why a political system tends to follow its own specific purposes. Democratic rules in various forms can hardly channel political action into the direction of the overall social purposes. Political agents tend to believe in a 'rationalist constructivism'. Such a conception maintains that all institutions which support the common purposes can be constructed in full awareness of their effects. Hence, the political agents try to replace spontaneous orders by artificial ones. They stipulate some exogenous rules which force the group members to adopt particular behavioral pattterns. Some specific knowledge is excluded from the interaction. However, the crucial problem is that such specific knowledge may be the source of the group's success. The political agents may (without awareness) weaken the position of the whole group in the institutional evolution. Therefore, Hayek suggests a further task for the social scientists. They should teach any individual the limits of her own knowledge. In particular, they should teach the political agents to what degree political actions are really forseeable. This way, the political agents might become more cautious, change less but better follow the purposes of the group as a whole.[14]

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[12]See Hayek (1937, 1945).

[13]See Hayek (1945, 1967a).

[14]See Hayek (1979a, 1967d, 1974).

# 3 Revisions and Extensions

Hayek was born in Vienna (Austro-Hungarian Empire), in 1899. He grew up in a social environment which was characterized by an intense, diverse, scientific dynamic. His grandfathers were prominent scholars in the fields of statistics and biology. His father was a doctor and a close friend of Eugen von Böhm-Bawerk (economist). On his mother's side, he was a cousin to Ludwig Wittgenstein (philosopher). In 1918, Hayek started his academic career at the University of Vienna. He inscribed for law and political science, but also studied philosophy, psychology and economics. He worked at: the Monakow's Institute of Brain Anatomy, New York University, the Austrian Accounting Office (issue: debts of war), and the Austrian Institute for Business Cycle Research. In 1929, Hayek became a professor and held lectures in economics, at the University of Vienna. Two years later, he left Vienna to join the London School of Economics.

Thus, Hayek developed a broad scientific base. He firmly believed that such a broadness was needed to advance in the analysis of specific social scientific problems. According to him, the social sciences deal with the relations of human beings to other human beings or to things. Human beings are generally free to choose. Thus, human relations may get influenced by subjective conceptions; which can make them extremely complex. The high potential for complexity implys the necessety for interdisciplinary research.

In Hayek's analysis of the interdependencies between the cognitive and the social order, three disciplines play a major role, namely: Evolutionary Epistemology, Cognitive Psychology, and Systems Theory. Hayek became already acquainted with each of them in the early years of his studies in Vienna. At this time, each of them was still in its infancy. Hayek received sustaining inspirations: by his friend Karl Popper in Evolutionary Epistemology, by the 'Gestalt school' in Cognitive Psychology, and by his friend Ludwig von Bertalanffy in Systems Theory. These inspirations became cornerstones of his related analysis, until his death in 1992. However, each of the three disciplines has evolved much more broadly, until today. It seems expedient to integrate some of their further aspects into the analysis. In the following, we are going to take up this task.

## 3.1 Evolutionary Epistemology

Evolutionary Epistemology bases its statements on a central postulate which is called 'hypothetical realism'. Hypothetical realism describes a distinct ontological position. It contains five major assumptions: First, there exists a real world; its existence is independent of our consciousness. This assumption helps to explain, for instance: why human beings may understand each other and coordinate their actions, by communication; why different (scientific) methods may lead to similar results. Second, the real world is consistently structured. Thus, we become able to understand the world; our actions can follow some purposes. Third, the real world and the mind interact. Due to this, structures of the two distinct worlds can adapt to each other. Fourth, the mind is a product of the nervous system. In order to understand the content of our mind, we therefore have to analyze the structure of our nervous system. And fifth, all our knowledge about the real world must remain hypothetical. This already follows from the fact that we cannot prove any of the other assumptions.

Evolutionary Epistemology conceives 'knowledge' as an internal reconstruction of external objects. We understand an external object to the degree that the related structure of our mind is isomorphous to the structure of the object. Thus, understanding is a creative process of our mind. A central question of the Evolutionary Epistemology is, how our mind has become able to create isomorphous structures. In other words: Why may the subjective structures of human knowledge fit the objective structures of the real world?[15]

All our knowledge is created by our nervous system. Our nervous system carrys out an internal reconstruction of external objects that it encounters in its environment. The structure of our nervous system is a result of evolution. Evolutionary Epistemology distinguishes two types of evolution: the biological and the cultural one.

In the biological evolution, the nervous system is also subject to the principle of 'mutation, selection, retention'. Any organism seeks to survive and reproduce. In order to succeed, the organism has to adapt to its environment. The structure of the organism is determined by its genes. Thus, the adaptation process starts with the mutation of a gene. The mutation may directly affect the nervous system, or not. Evolutionary Epistemology supposes that such a mutation is 'blind'; which has two implications: first, it does not follow a specific plan; second, it does not have an impact on any other mutation. Thus, the organism encounters its environment in a changed structure. If the new structure better fits the environment, then the organism may survive and reproduce. This way, the genes are selected and retained. The biological evolution proceeds rather slowly; the possibilities for an organism to succeed are rather limited. Evolutionary Epistemology therefore maintains that the chances for the human being to survive have been very

[15] See Vollmer (1985); Vollmer (1975), part B.

special.

In the cultural evolution, our nervous system is guided by our mind. The principle of 'mutation, selection, rentention' is transferred from a genetic to a mental level. This means in particular that mutations are not blind, anymore. Now, they do follow a specific plan; and one does have an impact on another. The mind can adapt to its environment by changing the organism's behavior. The mind can learn by the principle of 'trial and error'. Evolutionary Epistemology describes the learning process by the following scheme:

$$P_1 \quad \rightarrow \quad TT \quad \rightarrow \quad EE \quad \rightarrow \quad P_2.$$

Thus, the mind encounters a problem ($P_1$); it contrives a tentative theory (TT) to solve this problem; the theory is tested and errors are eliminated (EE); from the solution of this problem arises a new problem ($P_2$). According to Evolutionary Epistemology, this scheme basically forms and infinite chain. Hence, it is inexpedient to ask which comes generally first: the theory or the experience. Instead, an earlier tentative theory always guides an experience; and thus gets revised. The basic structure of all our theories is derived from the structure of our nervous system. Therefore, the biological evolution penetrates into all our knowledge. This also implies that an individual mind guides his learning process towards the evolutionary success of his organism.[16]

However, evolutionary success does not necessarily imply 'truth'. Our nervous system is limited in its scope and imperfect in its functioning. In the biological and cultural evolution, it may thus pay off for an individual organism to behave just opportunistically. Nevertheless, our moral consciousness pushes us to search for the truth. Hence, Evolutionary Epistemology calls the truth a 'regulative idea of the sciences'. It characterizes the truth by correspondence and consistency. We may approach the truth, if we open our theories for a critical discussion. Thus, our theories become conscious and intersubjective; they are tested and compared. Basically, the sciences follow the same learning scheme as the individual mind. But, the sciences can control and correct each other. This will actually work the better, the more there exists a critical and constructive attitude towards errors. Interdisciplinarity may help to support such an attitude and to effectively find errors. Nevertheless, errors are also costly. To avoid unreasonable costs, scientists should make their tests in a gradual manner. Thus, they can help other human beings to better adapt to a changing environment.[17]

[16]See Popper (1972), ch. 3; Popper (1975); Campbell (1987).

[17]See Popper (1935); Vollmer (1985); Radnitzky (1983, 1987).

## 3.2 Cognitive Psychology

Cognitive Psychology deals with how human beings internally transform and use information. Some of its main areas of reasearch are: perception, thinking, memory, learning, decision making, and consciousness. The entity which carrys out all cognitive functions is the nervous system. Cognitive Psychology examines the nervous system's related operations. The examinations are guided by various core concepts. One of these concepts is that of 'mental representations'. A mental representation is an internal code for information. The concept assumes that all cognitive functions base on such representations. Internal codes determine how we perceive, think, memorize, and so on. Another core concept is that of 'architecture'. It assumes that all cognitive functions base on the architecture of the nervous system. Each subsystem is assigned a specific operation. The result of an operation depends on the nervous system's physical substances and design.

A cognitive psychologist disposes of a wide range of methods to better understand how human beings internally transform and use information. The research methods can be classified along two dimensions: internal versus external, and controlled versus uncontrolled. One external and uncontrolled method is introspection. According to this, the researcher observes his own cognitive behavior, possibly guided by self-experiments or meditation. Advantages of this method stem from its directness; disadvantages from the influence of unconscious operations. Today, the most widely used internal and controlled methods are 'neurorecording' or 'neuroimaging'. Such methods incorporate technology to create external scientific records or images of internal mental operations. They measure for instance: anatomical structures (X-ray computed tomography, magnetic resonance imaging); blood flows (positron emission tomography, functional magnetic resonance imaging); or chemical reactions (electroencephalography). Their advantages stem from the deepness and the intersubjectivity of the observation; their disadvantages from the unnatural experimental environment.[18]

Cognitive functions are carried out by the nervous system. The nervous system consists of a specific structure of subsystems. On the highest level of this structure, we have the central (CNS) and the peripheral nervous system (PNS). The CNS transforms and transmits all information within the whole organism. It is composed of the brain and the spinal cord. The basic elements of the CNS are the neurons. Neurons are information transforming and transmitting cells. They may connect with each other via synapses. Inside a synapse, one neuron may send a signal to another. The signal can be excitatory or inhibitory. Only if the excitatory signals exceed the inhibitory

[18] See Galotti (2004), ch. 1; Kellogg (2003), ch. 1.

ones, in a specific period, the receiving neuron does react. Thus, a basic code inside the CNS is that of an excitatory or inhibitory chemical, the so-called 'neurotransmitter'. The CNS is connected to the other parts of the whole organism via the PNS. The PNS is composed of the autonomic nervous system (ANS) and the skeletal system (SKS). The ANS controls the smooth muscles and some glands; which in general happens unconsciously. The SKS controls the striated muscles; which in general happens consciously. The basic elements of the PNS are the nerve fibres.[19]

The structure of our nervous system is a result of evolution. According to well founded estimations, animals evolved the first brain cells 700 million years ago; and the first brains 250 million years ago. In the evolutionary process, a rudimentary human brain appeared only 3 million to 4 million years ago; the modern human brain only 100,000 to 200,000 years ago. Out of all species, the modern human being has the largest brain. Our CNS contains around 1 trillion ($10^{12}$) neurons and around 1,000 trillion ($10^{15}$) synapses. It is most probably the most complex system on earth. Due to our nervous system, we have been able to adapt, to prevail, and to develop various cultures.[20]

Nevertheless, our nervous system is far from being perfect in the sense that it does not represent, by itself, the external physical world as this world really is. Cognitive Psychology has discovered, described and explained many instances of such imperfection. In our context, two major respective fields are: perception and decision making.

The central task of our nervous system in perception is to treat the stimuli from the environment such that our mind can give them a meaning. What our nervous system does is to transform and to classify the stimuli. Then, our mind seeks to recognize patterns in this classification. In the process of pattern recognition, the mind uses two basic methods: 'data-driven' or 'theory-driven'. According to the data-driven method, the mind focuses on special parts of the transmitted data, as for instance: edges, lines, corners, or intersections. Then, it combines these parts to a whole. According to the theory-driven method, the mind starts with some expectations in the form of a theory. Then, it selects special parts of the transmitted data to test the theory. In each perception, both methods are involved. Which of these dominates, also depends on the object's characteristics; how difficult it is to perceive, for example. One basic problem of our mind in perceiving visual objects is to distinguish them from their backgrounds. The 'Gestalt school' stated the following: Out of all possibilities to combine visual data

[19] See Kolb/ Whishaw (2001), chapters 2-5.
[20] See Kolb/ Whishaw (2001), ch. 1.

to a whole, to a 'Gestalt', our mind tends to select the simplest and most stable one ('law of Prägnanz'). However, it seems not to be the case that the real external world tends to create its objects in the simplest and most stable form.[21]

The central task of our nervous system in decision making is to collect, to evaluate, to restructure, and to select action related information. Typically, a decision making process can be divided into five stages: 1) set goals; 2) gather information; 3) contrive alternatives; 4) structure decision; 5) make final choice. Surely, the process may sometimes leap backwards before it reaches stage 5. A decision can generally be considered as rational, if the mind chooses the alternative which best satisfies the given goals. However, cognitive psychologists observed and analyzed many instances in which a human being does not behave rationally. The human mind tends to deviate the more from rationality, the more risk or uncertainty is involved in the decision. Cognitive psychologists assign such deviations to categories, as for instance:[22]

- Availability heuristic: The probability estimation of an event is based on how easily the related information can be retrieved.
- Representativeness heuristic: A given outcome is supposed to represent a typcial characteristic of the related process.
- Anchoring: Initial outcomes dominate final choices.
- Framing: Alternatives are evaluated as positive or negative changes from the current state.
- Sunk cost effect: Lost investments dominate decision in a new context.
- Hindsight bias: Exaggeration of certainty which could have been assumed, previously.
- Confirmation bias: Focus on information which can confirm initial expectation.

[21]See Galotti (2004), ch. 2.
[22]See Galotti (2004): ch. 12.

## 3.3 Systems Theory

Systems Theory defines a system as a set of elements which are related in a specific mode. This means that these relationships are supposed to be more intensive in a certain respect than others. Hence, the set of elements is sourrounded by certain boundaries. The boundaries describe the relevant differences between a system and its environment. The environment contains all elements that the system is related to in a different mode. The system thus constitutes a whole that depends more on the internal than on the external elements. The system constitutes a functional unity.

Elements relate to others in order to generate specific functions. In a function, the value of one variable depends on the value of other variables. In a given system, an element may belong to various subsystems. Each subsystem carrys out a specific subfunction. Each subfunction may be constrained. This means that the range of a variable under the given conditions is less than under other conditions. Hence, a system becomes limited in its operations; the constraints determine how the system cannot relate to its environment. The set of remainig alternatives is described by the term 'contingency'. More precisely, contingency describes a system's degrees of freedom in its internal operations. For related systems, it constitutes a source of uncertainty or even conflict.

To reduce uncertainty or to solve conflicts, systems may communicate with one another. In a communication, two related systems seek to exchange information. To give the information a meaning, the two systems need a common code. Systems Theory defines a code as a set of rules or a mapping which establishes a correspondence between the symbols of two distinct languages. To maintain all the information from the sender to the receiver, the code must establish a one-to-one correspondence. With a one-to-many or a many-to-one code, by contrast, information is lost. Then, the receiving system classifies the information according to its own specific linguistic structure. To control the meaning of the communication, the two related systems may give feedback to one another. This means that the re-classified information flows back to the initial sender. Generally, negative feedback reduces the deviations of meaning, and thus stabilizes the relationship; positive feedback has the opposite effects.

Hence, communication may generate order in the relationships between (sub-)systems. The sender restricts the domain of meanings for the receiver. The receiver can select its input only within this domain. The input determines its operation. The sender thus controls the receiver, in some sense. The relationship further constraints the operations of both integrated systems.

In Systems Theory, a system which produces something different from the own elements and relationships is called 'allopoietic'. Its operations thus directly depend on the conditions within the environment, on the 'state of nature'. By contrast, a system which is oriented towards the reproduction of itself is called 'autopoietic'. Surely, a system can never be merely autopoietic. It always needs the interaction with an environment, at least for the input of energy or information. But, internal and external relationships are selected by some internal rules. The autopoietic system is thus independent in the control of some subsystems. It can stabilize itself in a circular process.

A system, no matter if allopoietic or autopoietic, may develop emergent characteristics. Systems Theory describes those characteristics as emergent which arise from the system as a whole, but not from its elements in isolation. Hence, emergence is the product of a system's selective relationships; internal or external ones. It causes the whole to be more than the sum of its parts. While 'emergence' describes this effect in qualitative terms, 'synergy' describes it in quantitative ones. Synergy is the quantitative difference between the product of a system and the product of its subsystems. The difference can be positive or negative.

A general characteristic of a system is its complexity. Systems Theory describes complexity as the extent of relationships, their embeddedness and entanglement. Embeddedness refers to the density of relationships with other systems. Entanglement refers to the dependence on other systems. The more complex a system is, the more uncertain are its operations, the more extensive are the potential conflicts with its environment. Therefore, complexity incurs an equivalent degree of communication and constraints. The overall order needs to adapt to the different complexities of the involved systems.

The evolution pushes a system towards a higher degree of complexity. Since the environment changes, the system needs to change its relationships in order to maintain its functions. It thus becomes more contingent. A higher contingency of interrelated systems can be coordinated in a higher complexity. However, a system may seek to keep its internal structure. As a result, it would have to select its external relationships more selectively. Its boundaries would become stricter. Systems Theory examines evolution under five major aspects: the principle of mutation, selection, retention; its stochastic; its opportunistic; its autopoietic; and its autocatalytic nature.[23]

Based on Systems Theory, the nervous system can be regarded as a autopoietic system. One can show that the nervous system is, in its essential character, operationally closed. It forms an autonomous unity of subsystems which seek to stabilize the functions of the whole while they adapt to external changes. The subsystems carry out a function by an interaction of states

[23]See Bertalanffy (1968); Willke (1993).

of relative neuronal activity. One and the same function may be carried out by various subsystems in various contexts. The potential contingency of a nervous system stems from this variability. Constraints to the contingency are built by the nervous system's organic structure; which is a result of the evolution. More precisely, the organic structure is determined by its genes in the phylogenetic process, and by its interactions in the ontogenetic process. Thus, the nervous system deals with a continuous recursion of representations. For its mode of operation, it does not matter whether a representation was internally or externally generated. Various representations may be combined and transformed. Altogether, the nervous system refers to itself.[24]

Only if a system is self-referential, it can interact with external objects without loosing its operational autonomy. Moreover, a system may need the interaction with external objects in order to carry out specific functions. Nevertheless, changes of the external objects lead to perturbations in the system's operations. In order to stabilize its operations, it must become more selective, then. Hence, in the process of evolution, a system tends to become more complex. It only can maintain its operational autonomy, if it adapts its control mechanisms.

A central issue of Systems Theory is how various control mechanisms work within a system of organized complexity. The Theory distinguishes at least five essential characteristics of organized complexity:

1. The relationships between the systems are non-linear. Causes and effects are therefore difficult to determine.

2. In general, the system is sluggish; it hardly responds to external interventions.

3. The system has some sensitive spots. If these spots are touched, the whole system responds, excessively.

4. The system is operationally closed. It thus develops a higher internal complexity; more operations become internal.

5. The system relys on specific internal control mechanisms. Such mechanisms make the external operations intransparent and uncertain.[25]

There are two major reasons why modern social systems have to deal with organized complexity in particular ways: first, the speed of their evolution is particularly high; second, they seek to enforce particular moral values. Thus,

[24]See Maturana/ Varela (1984): ch. 7; Maturana/ Varela (1980): part 1, ch. 4.
[25]See Willke (1994), ch. 2.

a modern social system faces the problem to integrate highly differentiated subsystems, to coordinate highly contingent behavior. We can find a great variety of control mechanism in a modern social system. One type of such mechanisms bases on various symbolic systems, as for example: language, power, money, or expertise. However, the effect of each symbolic system depends on its specific environment. One symbolic system can be a part of another one's environment. An adequate control mechanism is thus difficult to find and to install. Nevertheless, there appear three basic principles for the respective rules: generality, abstraction, and decentralization.[26]

# 4 Summary

Hayek developed a far-reaching approach to describe and explain the interdependencies between cognitive and social order. From a today's perspective, some outer parts of this approach need to be revised or extended. In particular, current insights from Evolutionary Epistemology, Cognitive Psychology, and Systems Theory help to further increase the descriptive and explanatory power of Hayek's approach. Thus, the main statements of the revised and extended approach can be summarized as follows:

Cognitive order arises in our nervous system. The nervous system carrys out all cognitive functions, as for instance: perception and decision making. It is most probably the most complex of all existing systems. The nervous system consists of a specific structure of subsystems: CNS, PNS, brain, SKS, forebrain, cerebellum, and so forth. The basic elements of the CNS are the neurons. Neurons are information transforming and transmitting cells. They may connect and communicate with each other via synapses. The structure of such connections is quite flexible. Hence, the nervous system carrys out its functions by activating various subsystems. There arise specific patterns of activity. Information is classified and reclassified according to these patterns. As a whole, the nervous system has the goal to support the survival and reproduction of the respective organism. It seeks to control its basic operations without reference to its environment. On a basic level, many operations thus become circular. The nervous system stabilizes such circularity by selecting external relationships according to internal rules. Hence, the nervous system can be regarded as autopoietic and self-referring. Based on its complexity, the nervous system generates various emergent characteristics. Its operations reveal more than the sum of its involved subsystems. In relation to its environment, the nervous system appears as highly contingent. There

[26]See Willke (1993), ch. 4; Willke (1995), part 2.

thus exists a high potential of conflict between them. The nervous system has learned to adapt to its environment in the course of evolution. In the phylogenetic process, it adapts by its genetic structure; in the ontogenetic process, it adapts by its neuronal patterns. The basic principle of learning is the same in both processes:

$$P_1 \quad \rightarrow \quad TT \quad \rightarrow \quad EE \quad \rightarrow \quad P_2.$$

However, while in the phylogeny, variations of TT happen 'blindly', in the ontogeny, they happen expediently. Hence, there always may exist discreprepancies between the structure of the nervous system and the structure of its environment; between world 2 and world 1. In decision making, the following categories of discrepancies, for example, may become apparent: availability heuristic; representativeness heuristic; anchoring; framing; sunk cost effects; hindsight bias; and confirmation bias.

Social order allows the members of the respective group to coordinate their actions. Human beings join groups to satisfy certain needs, to stabilize the exchange with other members. A group is characterized by specific rules and specific purposes. A group member mainly learns the specific rules in the exchange with other members. He adapts his action patterns to the norms of the group; his related actions feed back to the norms of the group. Each learning step follows the principle of trial and error. This may happen consciously, or not. The success of the exchange depends on the degree to which the member assign similar meanings to certain actions; to which they understand each other. Individuals can the better understand each other, the more they share in their phylogenetic and in their ontogenetic developments; the more they share in their cognitive and in their behavioral patterns. There can arise two general types of social order: The artificial one is exogenous, concrete, simple, and centralized. The spontaneous one is endogenous, abstract, complex, and decentralized. The two types of order tend to generate different effects, mainly because the second allows the members to integrate and to use more knowledge. This is because of the 'fact of our irremediable ignorance': Particular knowledge can hardly be transferred, in a conscious, direct, and comprehensive manner. No central entity can gather all particular knowledge and deliberately channel it into specific and consistent rules. In the process of instituional evolution, a group needs to adapt to its changing environment. A system of social rules can only survive, if it makes the group as a whole more successful than others. This is because groups compete for membership. In the process of institutional evolution, the environment tends to push a group towards a higher degree of complexity. In response, the members need to adapt their action patterns, the group as a whole needs to adapt its rules, its control mechanism. However, such adaptations may stand in conflict with the involved instincts, traditions, intellects.

Any real problem in the social sciences is due to evolution. Due to evolution, a human being has to adapt her cognitive and her behavioral patterns in order to succeed in the pursuit of her own purposes. The central question is: How can individual actions, based on dispersed and imperfect knowledge, lead to consistent and beneficial social results? Thus, the central task of the social sciences becomes to describe and explain the principles of a social order. In this task, the social scientists also follow the basic learning principle ($P_1 \rightarrow TT \rightarrow EE \rightarrow P_2$). As specialists, however, they are supposed to develop and use more precise methods. To reach a higher precision, they have to obey to some overall scientific rules. The most important one is that they make their theories intersubjective. Based on intersubjectivity, the theories can be discussed. A discussion will be the more fruitful, the more there exists a critical and constructive attitude towards errors. Interdisciplinarity will strengthen such an attitude and help to find errors. From the social sciences' central task, two further tasks can be derived. First, to revise some inadequate cognitive pattern. In its representation of the real world, our nervous system partially tends to deviate. A change of a deviating pattern may help us to better adapt our behavior to the real changes in our environment. Second, to revise some inadequate social rule. A social order need not by itself reconcile the particular purposes of the members with the general purposes of the whole group. A change of a deviating rule may help us to better follow the general purposes. For the success in both tasks, it appears as essential to recognize the limits of our knowledge.

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