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CONTEXTUAL EMERGENCE
AND ITS APPLICATIONS IN PHILOSOPHY OF MIND
AND COGNITIVE SCIENCE*

Emergence relates to phenomena that arise from and depend on some more basic phenomena yet are simultaneously autonomous from that base. [...] Emergent phenomena are Janus faced: they depend on more basic phenomena and yet are autonomous from that base. Therefore, if emergence is to be coherent it must involve different senses of dependence and independence.

(BEDAU & HUMPHREYS 2008, 3)

1. INTRODUCTION:
EMERGENCE AS A TRANSDISCIPLINARY CATEGORY

Marc Bedau and Paul Humphreys, editors of the anthology *Emergence: Contemporary Readings in Philosophy and Science*, draw attention to the issue that the ontological concept of emergence relates to phenomena which *emerge* or are *dependent* on some more basic phenomena and yet, at the same time, which retain a certain degree of independence from them (cf. BEDAU & HUMPHREYS 2008, 1–6). Herbert Simon expresses a similar thought when he states that the special sciences, examining high-complexity systems, are *simultaneously dependent and partially autonomous* in relation to more basic disciplines which examine systems of a lower level of complexity. This can be interpreted as a theoretical-conceptual indicator of ontological emergence (cf. SIMON 2008, 249–58).

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Particular levels of organization of nature, while not reducible to one another, are also not fully autonomous. The so-called spheres — physical, chemical, biological, mental, and socio-cultural ones — do not form a discrete hierarchy of organizational levels independent from each other, but rather a multilaterally connected and ramified network which approximately corresponds to the hierarchy (network) of scientific disciplines. According to the emergentist image of reality, all complex systems, as well as the processes, functions, and states that take place within it, emerge based on simpler systems and their effects, towards which they are ontically derivative. Yet the opposition between that which is ontically derivative and that which is ontically basic does not have an absolute character, but a relative one. Phenomena, considered to be basic on one level, can be considered derivative on another level of organization. Cells (the building blocks of life) are basic in relation to higher level structures, such as body tissues, organs or multi-cellular organisms; but they are derivative in relation to the particles, chemical reactions, and physical interactions that compose them. A developed human mind is ontically basic in relation to purely intentional creations; however, it remains derivative in relation to the hierarchical structure of neural nets constituting the human brain and, in a broader perspective, in relation to the evolutionary processes that have led to its development.

The condition for the possibility of the existence of any given higher-level structure (properties, functions, regularities) is the existence of particular basic units, the appropriate systems and combinations of which constitute an existential foundation of the higher-level structures. The ontic dependency we are dealing with, in this case, has an existential, structural and functional aspect. The *existential* aspect of the relation consists in the fact that the destruction of basic units annihilates all derivative units and systemic functions that were based on them or in reference to them. The *structural* aspect of relations of dependency consists in the fact that the basic units — due to appropriate functional organization — constitute higher-level structures. Finally, the *functional* aspect of the relation of dependence consists in the fact that, for every systemic function there are lower level mechanisms which enable its execution. The aforementioned aspects of the dependency relations, described in the abstract language of ontology, relate to the existence, structure and functioning of cells as well as of mental-cognitive systems to an equal extent.

Supporters of the emergence theory do not usually consider mental phenomena to be the only examples of emergence in the natural world, but — at

most — they consider them to be the most spectacular case. Within the emergentist image of reality, mental-cognitive processes constitute an integral factor of the multi-level structure of the physical world. They exist on a suitably high level of organization and depend in many ways (existentially, structurally, and functionally) on the physical, chemical and neurobiological processes that underlie them. The laws of the basic disciplines enable the evolution of structures at a level of complexity required for the realization of such functions as consciousness, memory, or thinking. However, they are not able to explain all of the details connected with their realization — they determine the necessary conditions, but are insufficient for the existence and the functioning of the mind. In order to explain all of the aspects of the way in which mind functions, one needs appropriate exact sciences of a higher level, especially those of a contextual character, i.e. developmental, environmental as well as socio-cultural.

The purpose of the article is to analyze the concept of contextual emergence as well as its selected applications in philosophy of mind and cognitive science. In the initial sections, I present the general assumptions of the emergentist model of reality (George Ellis, Philip Clayton). I stress, in particular, that the concept of emergence can be applied to the description of various levels of organization of nature: one of these levels is that of mental-cognitive processes, analyzed within the fields of philosophy of mind and cognitive science. In the subsequent sections, I introduce the definitions of *contextual emergence* (Harald Atmanspacher) and *systemic causation* (Michael Silberstein), and I also note to their selected applications in reference to mental-cognitive systems. In the concluding part I present the ideas of Gerald Edelman and Michael Gazzaniga on the role of contextual explanations as well as the concepts of emergence in the philosophy of biology and cognitive neuroscience. I also indicate the possibility of incorporating the concept of contextual emergence to active externalism (Andy Clark, David Chalmers) and to the extended cognition theory (Robert Wilson).¹

¹ Various concepts of emergence function in the literature on the problem. A detailed discussion goes beyond the scope of this article. The fact that epistemological criteria are generally used in ontological definitions deserves emphasis. The concepts of emergence most frequently have a mixed character, i.e. ontological-epistemological. This is understandable, because we always describe the structure of the world with the aid of a theory that we have at our disposal at a given stage of the development of scientific knowledge. In this article I omit the theories of emergence which are used for the sake of explaining psychophysical dualism (their accurate critical analysis is contained in the works of Jaegwon Kim).

2. EMERGENCE ACCORDING TO GEORGE F.R. ELLIS AND PHILIP CLAYTON

George F.R. Ellis presents a concise conceptualization of the phenomenon of emergence in his article “On the Nature of Emergent Reality” (cf. ELLIS 2006, 80–85). The author formulates his position in terms of the following set of theses:

a) The phenomenon of emergence takes place in various ways in different contexts—depending on whether we refer to physical, biological, mental-cognitive or social systems and artifacts. Nevertheless, the differences that appear do not exclude the existence of similarities between the particular cases of emergence.

b) Emergence occurs in the case of multilevel hierarchical structures, where various levels of organization correspond to various laws formulated in the languages of the theories of various levels. Every level of organization is signified by a type of causal relation, specific for it, which cannot be adequately—without a loss of information—described in the languages of the theories referring to the lower level of the systemic organization.²

c) Hierarchic systems are modular, i.e. they consist of structured combinations of relatively autonomous components fulfilling specific functions and having an array of distinct internal states. In such systems many lower-level microstates may correspond to one global microstate on a higher level. A description of the upper level is the result of the operations of averaging over lower-level states, which is accompanied by reduction of information.

d) Emergence can involve the creation of a new species, individual or functional. Every type of emergence is a result of the adaptive selection that takes place in the interactions with the environment (physical, biological, social), which constitutes the boundary conditions of a given system. The emergence of structures consisting of simpler physical structures is possible thanks to, among others things, the non-linear interactions taking place between its components, as well as the non-linear interactions of the system with its environment (the non-linear and contextual dimension of emergence).

e) The process of emergence is enabled by the simultaneous coincidence of: (i) bottom-up influence; (ii) interactions on a given level of the hierar-

² According to Ellis this also refers to macroscopic physical theories constructed on the averaging out of causal relations of a lower level. Such theories essentially describe new relations in reference to the ones appearing on the micro-level. Cf. ELLIS 2006, 81.

chical system; and (iii) top-down influence. The causal-informational interaction of the (ii)-(iii) types requires the coordination of lower level interactions by the holistic structure of the system and its boundary conditions. The upper-level laws—determining behaviors specific of a particular organizational level—appear when many lower-level states, corresponding to one particular upper level, lead to the specific behavior on an upper level. The system cannot exist or function as a whole, if all of the above-mentioned types of causal-informational interactions do not coexist in it.

f) Living systems are structured in such a manner which enables them: (i) to control their behavior with the use of a feedback mechanism;³ (ii) learning through: (iii) the reception, storage, reproduction and the analysis of information; (iv) recognizing patterns; (v) creating models of the environment (which are the conditions for accurate predictions; (vi) abstraction and the ability to consciously operate with symbolic representations.

g) Emergent phenomena, specific for the intentional level (concepts, notions, ideas, plans, intentions, and goals as well as socially constituted rules and norms), are causally effective in the realm of fields, particles and physical interactions, which is why it is justified to think of them as equally real.

Ellis assumes the existence of five levels of emergence which roughly correspond with the major breakthroughs in the evolutionary history of the Universe. At the first level of interactions, bottom-up influence leads to the creation of upper-level generic properties. This sort of emergence leads to the emergence of the generic properties of gases, liquids and solids, assumed in the particular physical laws. In principle, reductional explanations are possible in the case of this form of emergence, although they still are subject to multiple practical limitations. The second level of emergence consists of the fact that the bottom-up influence—taking into consideration the active role of boundary conditions— leads to the appearance of interesting upper-level structures, such as convection patterns, cellular automata, gravitational structures emerging in the expanding Universe, and non-organic and organic particles.

At the third level of the bottom-up influence highly structured control systems with in-built feedback mechanisms appear. These, in turn, enable the realization of innate, pre-programed “goals” (teleonomy). At this level the behavior of the system is dominated by evolutionarily inherited patterns (information) specific to a particular species, whereas the impact of learning

³ The existence of supervisory systems with an in-built feedback mechanism is one of the conditions for the possibility of goal-driven behavior typical for intentional systems. Cf. ELLIS 2006, 84.

from one's individual experiences is relatively low. This is the manner of the processes that take place on a supramolecular level (in cells and plants).

At the fourth level, control systems with in-built feedback mechanisms appear. These are ruled by clearly defined purposes co-designated by the individual memory (learning processes) and the individual history of a given system. This is a level specific for animals endowed with a nucleus of germinating consciousness, large flexibility, and adaptiveness of behavior as well as the ability to communicate in a simple manner. At the fifth level the ability to represent the environment symbolically (intentionality), understanding, rational choice (motivated by values as well as socially constituted norms and rules), self-awareness, and self-assessment appear. Capabilities of this type are present in a developed form among the representatives of *Homo sapiens* who are endowed by appropriately sophisticated and structured brains. Emergence at the fifth level is linked also with the capacity to manufacture various mental artifacts, i.e. objects ascribed to Karl Popper's World 3, such as ideas, concepts, designs, works of art, and scientific theories (cf. ELLIS 2006, 99–101).⁴

Philip Clayton proposes an approach to emergence similar to that of Ellis. According to him, the core of the emergentist theory is expressed in eight fundamental theses:

a) *Material monism*: there is only one basic material from which all of the objects of the natural world (broadly understood Nature) are made of. This, however, is neither traditional materialist monism (with its outdated concept of matter), nor spiritualist monism (with its outdated concept of the spirit), but a neutral monism that discards the Cartesian dualism of matter and mind as well as the positions of reducing the mind to matter (traditional materialism) or matter to the mind (traditional idealism) (cf. CLAYTON 2004, 59–61).⁵

⁴ The abovementioned provisional systematization of the more significant levels of emergence produces, in return, a more approximated image of reality. Ellis is perfectly aware of the deep theoretical problems that the ontology of emergentism encounters, as is signified by the following words: "What is not obvious is whether true emergence is ever possible: that is, the creation through physical and biological processes of completely new types of structures and information without any kind of precursor — the creation of a completely new kind of order — or the emergence in the physical world (which undoubtedly happens) is rather just the realization of pre-existing potential and hence not a truly creative event. Complex objects are certainly preceded by the possibility of their existence, that is, their pre-image exists before them in a possibility space delimiting what is physically possible in the real universe; otherwise they could not come into existence." (ELLIS 2006, 85).

⁵ According to the author of this article, Clayton rightly expresses the conviction that the post-Cartesian dispute between materialism and idealism assumes inadequate concepts of matter

b) *The hierarchy of complexities*: reality is structured in a hierarchical manner—more complex units are formed from simpler ones. Yet together with other systems, complex systems may create structures with an even higher level of organization and, at the same time, their constitutive elements may be compilations of elements simpler than they are. We observe that objects of the natural environment tend spontaneously to form ever more complex hierarchical systems.

c) *Emergent evolution*: the process of the emergence of hierarchical systems takes place in time. Biological evolution, as well as a broadly understood cosmic evolution, moves (at least to a certain degree) from the simple to the complex. During this process, new structures emerge which display new types of properties and functions.

c) *The lack of uniform laws of emergence*: due to the remarkable diversity of structures created by evolutionary processes, there are no uniform universal laws enabling the emergence of all levels of the organization of the natural world. However, this does not mean that there are no local laws of emergence responsible for the creation of systems specific for particular organizational levels.

d) *Patterns of emergence through levels of organizations*: despite the lack of universal laws of emergence, there are clear similarities between the particular cases of emergence in natural history. For any given organizational levels of the natural world, L_1 and L_2 , such that L_2 is the emergent level in relation to L_1 (L_2 emerges out of the L_1 level and is added onto it), the following dependencies hold: (i) L_1 exists at an earlier stage of natural history than L_2 ; (ii) L_2 is ontically dependent (not autonomous) from L_1 (if there were no objects and properties belonging to L_1 , there would neither be objects and properties belonging to L_2); (iii) the emergence of L_2 is the consequence of reaching a specific level or critical threshold of complexity at L_1 , after the crossing of which a given system begins to manifest emergent properties (in relation to properties specific for the L_1 level); (iv) the prediction of the appearance of the level L_2 properties based on the knowledge referring to the L_1 level is possible only to a limited extent (usually only *ex post*); (v) level L_2 is not reducible to level L_1 (levels L_1 and L_2 are essentially different organizational levels).

and mind (consciousness), over unfamiliar with the Greek tradition. Overcoming this dispute and the concepts presumed on its grounds requires the redefinition of the basic categories with which it was formulated. Such a recategorization is possible with an emergentist outlook. Clayton uses the term “monism” in a neutral meaning. The nature of the ultimate material from which the world is constituted most probably still remains undiscovered.

e) *Downward causation*: processes taking place at level L_2 cause effects at level L_1 , which cannot be explained exclusively by cause-and-effect processes that take place at level L_1 and at lower levels. Hierarchical systems develop in such a manner that systems which are created are equipped with new causal powers that influence processes taking place at the level of their internal structure.

f) *Emergentist pluralism*: every level of organization of the natural world is as real as any other. Cells are no less real than chemical particles, although the mode of their existence is different (the existence of cells depends on the existence of chemical particles, but the opposite is not true). Emergentism is an ontological pluralism, because (unlike ontological dualism) it does not divide reality into two mutually exclusive levels of organization (substance or property): mental and physical. In distinction to the radical types of reductionism it does not bring down reality to one fundamental level of organization.

g) *The emergent nature of the mind*: the level of organization on which mental-cognitive processes appear is one of many levels of organization of the natural world. These processes are real—they are signified by a distinct causal profile and, at the same time, they are grounded (not independently and derivatively) on all of the lower-level processes which constitute the conditions for the possibility of their existence. One of the tasks of the theory of psychophysical emergence is the consideration of all possible circumstances and of pre-conditions for all mental-cognitive processes as well as the determination of the manner and degree of relative autonomy of actions and mental states when comparing them to their basic states. This autonomy constitutes a condition for the possibility of carrying out rational decisions and intentional behaviors. The fulfillment of the abovementioned postulate, combining dependence and the relative autonomy of the mind, does not depend on the acceptance of a dualistic ontology, but on the understanding of the complex mechanisms that enable the appearance of a vast array of mental activities (rationality, freedom, responsibility, conscience, intentionality, mental contents, etc.) in the physical world.

The path to the realization of this goal leads through the integration of the best accomplishments of science and philosophy which takes place in relation to the mental-cognitive processes within contemporary cognitive science. Philosophers usually conduct their research “top-down” (in an analytical, phenomenological or hermeneutical manner), focusing on descriptions, analysis and interpretation of various forms of mental life. The representatives

of the empirical sciences, on the other hand, discover mechanisms of their realization at various levels of organization. The integrated ontology of the mind takes into consideration both types of data and constructs its consistent synthesis. According to the author of the article, such a synthesis leads to an emergentist image of reality and an emergentist ontology of the mind. This is an image that strongly integrates various levels of the world's organization (from a quantum level up until the conscious mind and its purely intentional creations), while leaving a necessary minimum of autonomy for the realization of higher, mental-cognitive functions. It is worth remembering that just as there are limits to reductionist programs, there are also limits to the theory of emergence. The psycho-physical problem cannot be solved with the aid of philosophical methods. The emergentist ontology of the mind only supplies an abstract conceptual scheme that elegantly describes the place of the mind in the physical world. A detailed explanatory enterprise must be carried out in the scope of the disciplines that constitute cognitive science. This does not diminish the role of philosophy, although it does lead to the abandonment of its foundationalist pretensions. The discovery of one's own boundaries is one of the important results of the interactions between science and philosophy, as well as in the realm of interdisciplinary research on the mind and cognition.

3. CONTEXTUAL EMERGENCE AND SYSTEMIC CAUSATION

An interesting version of emergence was proposed by Harald Atmanspacher (cf. ATMANSPACHER 2007). The author draws attention to the question of whether a description of properties present on a lower level of organization specifies only the necessary or also the sufficient conditions for the realization of the properties at a higher level. In other words: Is the relation of microdetermination, with which we are dealing here, complete or only partial? The point of departure for his proposal is the distinction between four possible relations taking place between various organizational levels within natural systems. Making use of the concept of necessary and sufficient conditions of realizing properties on a particular level, we face four possible situations:

a) A description of the properties of the system at a given organizational level delivers necessary and sufficient conditions for introducing a descrip-

tion of properties at a higher organizational level. This situation corresponds with the classical model of reduction which refers to the equivalence bridge laws according to Ernst Nagel's interpretation.

b) A description of the properties on a given organizational level provides the necessary, though insufficient conditions for deriving a description of a property at a higher organizational level. This is the so-called case of contextual emergence, whereby in order to generate a property on a higher level it is also necessary to fulfill an array of contingent contextual conditions exceeding the system's microstructure.

c) A description of the properties of the system at a given organizational level provides sufficient, yet unnecessary conditions for deriving a description of a property at a higher organizational level. This is the case of higher level properties that are variously realizable and that supervene lower level properties.

d) A description of the properties of the system at a given organizational level does not provide necessary or sufficient conditions to derive a description of a property at a higher organizational level. This is a case of extreme independence and autonomy at a higher organizational level as compared with a lower level in a particular hierarchical system (i.e. radical emergence).

According to Atmanspacher the case d) is not really interesting due to the lack of any explanatory (causative) relations between the participating levels. On the other hand, (a) constitutes a formulation of classical reductionism referring to the equivalence bridge laws which determine the necessary and sufficient conditions for a given state at a higher organizational level to take place in the categories of its microstructure. Both of these cases are unrealistic in reference to actual inter-level relations. Atmanspacher concentrates mainly on the case (b) which he calls "contextual emergence".⁶

The main theorem, which expresses the idea of contextual emergence states that the occurrence of new systemic properties on a given organizational level depends on whether at a lower level the basic necessary conditions of emergence of those particular properties are fulfilled, whereas the sufficient conditions are provided by a description of the contingent context which is unachievable from the lower level perspective. The necessary conditions are not exclusively upward (bottom-up), but they are at least in part of a contextual nature. According to Atmanspacher this refers to the

⁶ The author points out that the similarity of the concept of contextual emergence to the scientific approaches reduction (NICKLES 1973; BATTERMAN 2002), which he juxtaposes to philosophical concepts of reduction (more restrictive) as well as to the position of Roger Sperry's emergentive interactionism (SPERRY 1969).

thermodynamic properties of gases (such as temperature), as well as to the contextually co-determined mental properties and states.⁷

On the one hand, the concept of contextual emergence fits well into the ontological perspective of systems theory, as the reference to the environment (the system's exostructure) within it plays a key role in the procedure of explaining an important systemic class of emergentive properties. On the other hand it indicates that there are limits to microreductionist explanations. An important ingredient of the systemic image of the world is the theorem stating that higher level systems may affect their subsystems. The properties and the behavior of individual systems undergo changes, when they constitute the higher level system and, oppositely, some subsystems may regulate activities of the entire system. In this case we are dealing with a complicated network of feedbacks of upward and downward causation. Downward causation is also a defining trait of an important class of concepts of emergence. By downward causation we can understand regulation, limitation, the elaboration of boundary conditions for intrasystemic processes or active perpetration which we encounter at the level of self-aware intentional systems. The specificity of downward causation varies depending on the type of system with which we are dealing.

The concept of downward causation tends to be understood and assessed in a variety of ways. Claus Emmeche, Stefan K ppe, and Frederik Stjernfelt elaborate further on this approach in the context of systems theory, emergence theory and organizational levels theory (cf. EMMECHE, K PPE, & STJERNFELT 2000). They distinguish four main levels of reality: physical, biological, mental-cognitive and social. However, the relations of dependency that occur between particular organizational levels may vary among each other. For example, the dependence of the biological level on the physical level is not exactly the same as the dependence of the social level from the mental one. The physical level, which encompasses all the other levels, is situated at a distinguished position in this sequence of stratifying levels. According to the principle of the inclusivity of levels:

a) within the all-encompassing physical level, the process of emergence of new organizational levels does not breach or alter any physical law (laws of higher organizational levels do not change the rules of lower organizational levels);

⁷ Examples of the use of the concept of contextual emergence are discussed by Bishop and Atmanspacher (2006) as well as Primas (1998).

b) the ontology of the higher levels of reality has a local character in the sense that, e.g. various types of biological organizational rules (various forms of life) may be realized in a variety of realms within the Universe (in a natural or artificial manner). In other words, the fundamental physical level permits more than one way of realizing higher levels (this too relates to mental-cognitive processes) (cf. EMMECHE, KØPPE, & STJERNFELT 2000, 13–16).

The authors distinguish three versions of downward causation: strong (SDC), intermediate (IDC), and weak (WDC). They consider the first version to be inconsistent with contemporary scientific knowledge. Supporters of the SDC stance assume substantial realism in reference to organizational levels within the natural world which, according to them, are autonomous. An example of such an approach is classical vitalism (which assumes the existence of a non-physical force responsible for the organization of biological processes) as well as Cartesian substantial dualism (which assumes the existence of a non-physical substance or force that is responsible for the organization of mental processes). SDC permits the possibility of changing or breaching the laws that are binding at lower organizational levels under the influence of downward actions.

According to the authors this approach assumes a naïve perspective on inter-level relations that has been overcome long ago, resulting from the lack of understanding the actual dependencies with which we are dealing in this case. Most paradoxes of downward causation originate from the fact that the concept of downward causation fits into the dualist ontology of life and mind which permits the possibility of causing physical effects by non-physical causes. However, according to the principle of level inclusion, each upper level system (biological, mental-cognitive, or social) is a result of a specific organization of lower-level objects and, as such, has a physical nature (in a broad sense) (cf. EMMECHE, KØPPE, & STJERNFELT 2000, 18–23).

In the case of IDC, a system or an upper-level state begins to exist as a result of realization of one of many possibilities permitted by states or systems of a lower level. A pre-existing higher-level state appears here as a selection factor. The idea of IDC can be expressed in an exact sense using the concept of a boundary condition. In mathematics boundary conditions are sets of selection criteria, with the aid of which one can choose one of many solutions for a system of differential equations describing systemic dynamics. In reference to the theory of levels of reality, boundary conditions are those that select, as well as limit, possible developmental paths for a particular system. In such a case one can speak of constraining conditions. Such

conditions can exist only within the realm of complex, multi-level systems within a hierarchical architecture. Their role consists in selecting, or else limiting (from a higher level) the course of lower-level processes.

An example of such downward activity may be found in higher level organizational rules, in the sort of natural selection due to which evolutionary processes reveal specific patterns endowed with lawlike regularities. They do not breach any lower level laws, despite actively forming processes that take place at lower organizational levels—natural selection that influences, among other things, which genotypes shall survive in a particular ecosystem. Analogous situations can be seen in the way that the conscious system carries out a selection in a set of realizable behaviors. In this context the authors postulate the introduction of the concept of functional or teleological causation that would relate to the manner, in which a higher-level system supervises and limits the behavior of its subsystems (the case of social systems subject to downward control).

On the other hand, WDC, in contrast to IDC, does not refer to the interpretation of the mathematical concept of boundary conditions as the conditions for controlling and selecting, as well as constraining, conditions, but to the concept of the phase space and the attractor. One can assume that biological organisms consist of highly complicated attractors that define the behavior of macromolecules in a biochemical phase space. The relative stability of attractors can be interpreted as an expression of the biological regulation of lower level physical processes. In other words, the relative stability of the attractor is a way of managing processes, which can easily be interpreted as a case of downward causation—physical disturbances are regulated by a biological attractor. The attractor functions here as a whole at a level higher than the one, at which the processes that constitute it as well as depend on it occur (cf. EMMECHE, KØPPE, & STJERNFELT 2000, 28). According to the authors, the idea of WDC formulated in the category of attractors resembles in a number of ways Aristotelian formal causation and constitutes its contemporary conceptualization and verbalization (cf. EMMECHE, KØPPE, & STJERNFELT 2000, 26–31).⁸

The systemic treatment of downward causation has been also proposed by Michael Silberstein in the context of the analysis of the concept of emergence and mental causation. The author rejects the dualistic and micro-reductionist concept of levels of reality. In his opinion the organizational

⁸ A similar approach to emergence and downward causation (referring to the concept of the attractor) is presented by David Newman (cf. NEWMAN 1996, 145–61; 2001, 47–59).

levels should not be interpreted as independent layers constituting a discrete hierarchy, but as a structured, multilaterally branched network of mutually interacting systems and subsystems. According to Michael Silberstein: “The universe is not ordered as a hierarchy of closed autonomous levels such as atoms, cells, and the like. Rather, the universe is intrinsically nested and entangled. The so-called physical, chemical, biological, mental, and social domains of existence are in fact mutually embedded and inextricably interconnected. That is, mental properties are not on a higher level than neurochemical properties, the former are not on a higher level than chemical properties, and so on. It is best to view the world as divided into systems and subsystems, not levels—and even then, such divisions are often not ‘carved at the joints’ but nominal and relative to various formalism and explanatory schemas. [...] Mental properties as *qua* mental are causally efficacious with respect to physical or neurochemical properties; such causation is not ‘downward causation,’ however, but what I call *systemic causation*. It is not downward causation because ontological emergence rejects the layered model of reality as divided into a discrete hierarchy of levels.” (SILBERSTEIN 2006, 204).

Systemic causation assumes the existence of stable patterns on a systemic level, maintaining a relatively stable level of integration, despite constant changes taking place on the subsystemic level as well as on the level of higher-level systems (that include also the natural environment in which a given system is situated). Relatively stable patterns limit and determine the manner in which the internal systemic processes take place and at the same time are limited and determined by patterns at a higher level. In order to describe this type of causation Silberstein uses also the phrase *causation-as-constraint*, drawing attention to the existence of various forms of causation. In this approach one does not treat levels of reality as autonomous layers independent from each other, but as a hierarchical network of mutual connections and dependencies. The mental-cognitive level does not constitute an autonomous layer but is the aspect or dimension of an adequately developed network. Among others, for this reason the explanations of mental-cognitive processes cannot be homogenous (mono-disciplinary) but must have a multi-factored character which is achievable only in the mode of interdisciplinary research conducted within the domain of cognitive science (cf. SILBERSTEIN 2006, 204–07).

Mental-cognitive processes emerge based on self-organizing networks encompassing the brain and body, as well their environment, in various scales. They are not constituted exclusively by neural processes taking place in the brains, but by a global network of in-built conditions and dependencies

(physical, chemical, biological, neural, environmental, socio-cultural). Particular mental functions and properties (memory, perception, thinking, intentional behaviors, etc.) are always individualized in a relational manner and cannot be fully explained, described or elaborated in the framework of categories referring to neural mechanisms lying at their foundations. Systemic ontology assumes contextual emergence and leads to a relatively strong version of externalism (cf. SILBERSTEIN 2006, 208).

Externalism, in the theory of mind, constitutes a natural extension of the aforementioned statements. According to Silberstein, mental properties are: (a) not internal or categorical properties of mental states; (b) not fully determined (in whatever sense of the term “determination”) by the neurobiological properties lying at the foundations of processes within the brain; (c) not identical to or constituted by neural activity; (d) not fully determined by fundamental laws and physical properties. Mental properties have a broad and external character — they characterize systems that are dispersed throughout spacetime and that consist of relationships and interactions between the mind, brain, and body as well as the physical and social environment. In other words, neural processes are physically necessary, yet insufficient conditions for the existence of mental states. A complete analysis of mental states requires also reference to their evolutionary and historical context (cf. SILBERSTEIN 2006, 204).

Gerald Edelman takes a similar position. According to him no neurophysiological data can fully explain how the process of thinking occurs. Neurophysiological explanation is necessary, but insufficient. This is comparable to the statement that complete embryological explanation is necessary to explain the way humans look and behave, but it is not sufficient. A sufficient explanation must be based on evolution and must encompass the history of the organism and natural selection. Reducing psychology to neurophysiology must end in failure. Taking into consideration the fact that thinking depends on social and cultural interactions, conventions, and logic, as well as the fact that it is based on metaphors, purely biological methods are insufficient to explain the process of thinking (cf. EDELMAN 1992, 240).

The relation of psychology to neurobiology is in many ways reminiscent of the relation between biology and physics. According to Edelman, despite the fact that physics constitutes the basis for biology, it does not deal with biological structures, processes, and rules. Biological structures are more distinct, they exist only within particular temperature intervals of a particular level of energy and air pressure, as well as on the basis of specific chemical

processes. Biology is a strongly historical discipline, because evolutionary processes are based on a historically determined sequence of selective events operating on a diverse population of organisms. Analogous to the non-determination of biology by physics one can speak of the non-determination of the synaptic structure of the human brain by the human genome, as well as the non-determination of psychology by neurobiology or the non-determination of semantics by syntactics. The abovementioned cases of non-determination constitute the exemplification of general regularities connected with the micro-macro relation in reference to open systems (relatively isolated), depending on the fact that the micromechanisms and the microstructure of such systems constitute the necessary condition for the microproperties to exist, but do not determine them in a complete manner (micro-macro determination has a partial character by default).

This does not change the fact that the human mind cannot be comprehended without biology—neurobiology in particular. An adequate model of the mind must consist of many organizational levels and their mutual interactions. Not only must one describe, in detail, every level taken into consideration, but also the mutual interactions between levels. It is indeed the multitude of levels and not some mysterious physical principle which makes it so difficult to explain how the mind works. According to Edelman, taking into consideration the multitude of physical, biological and social levels which have to cooperate in order for a conscious mind to emerge, reducing the theory of unitary behavior to the theory of molecular interactions is simply not serious. It is not possible to comprehensively describe and explain the human mind using exclusively the categories of particles, fields and physiology. Radical versions of neuro-reductionism in mind theory are not acceptable because, among other things, the activity of the mind exceeds the Newtonian concept of causation; the way memory and consciousness work transcends the description of the consequences of physical behaviors in time, whereas the description of the individual “I” requires referring to the level of social relations. Social cognitive neuroscience not only explains in what way social behaviors are pre-conditioned by how our brains are organized, but it is also focuses on the opposite direction of determination, i.e. in what way the participation in social interaction influences the development of the neural network and the mental-cognitive states realized by them.

The criticism of radical versions of neuro-reductionism may also make use of the concept of contextual emergence. The point is that the manner in which mental-cognitive processes function and are organized is not only

determined by the endostructure of the cognitive system (the architecture of its brain), but also by its exostructure encompassing all relations and interactions between the system and the broadly understood environment (physical, biological, socio-cultural). Neurophysiological processes are the necessary substrate of cognitive processes. In order to perceive, speak, think, remember, or be aware, a brain functionally organized in a particular fashion is necessary, or else a structure that is functionally (causally) equivalent to the brain. The neurophysiological processes, themselves, do not constitute a sufficient condition for the formation and functioning of the mind.

On the grounds of evolutionary psychology, attention is given to the fact that the structures of our brains and minds develop in close interaction with the environment. The role of the environment in evolutionary-developmental processes is constitutive, in this respect, to the same extent as the role of genetical programming. The lack of adequate exemplars and stimulations hampers and disables the appropriate development of mental modules. The existence of such modules constitutes a sophisticated adaptation of the organism to the environment. Genetical programming, itself, is not sufficient for the emergence of a mature brain and its mental dimension: the consciousness, intentionality, mental contents, propositional stances, rationality, or axiological dimension. The mode in which the mind exists is irreducibly relational, whereas understanding its entirety is impossible, exclusively in the categories of the endostructure of our brains and genetic programs (cf. KARNILOFF-SMITH 1992).

A good example of relational (contextual) aspects of the mind is that of social emotions. In order to understand and explain such intentional states as envy, pride, or shame, it is not sufficient to indicate the activation of particular neurons or modules, the change of the flow of blood or increased consumption of oxygen, even though such reactions will probably occur. It is also necessary to include the network of interpersonal and social relations in which an individual participates. Even the complete knowledge about the brain of the person experiencing the feeling of envy cannot grant the understanding of the relational (contextual) factors that determine this emotion (cf. CHEMERO 2009; AYDEDE & ROBBINS 2010).

4. TOWARDS AN ACTIVE FORM OF EXTERNALISM

System-artifacts, such as cars, refrigerators or computers, have strongly modular structures in the sense that they consist of highly specialized components, the cooperation of which enables the realization of systemic func-

tions specific for them. Although their modules-parts are integrated in a specific way, we can easily disassemble such systems into simpler components, exchange them and assemble them yet again with the preservation of the systemic functions. The situation appears to be slightly different in the case of living organisms and those endowed with mental-cognitive properties which we cannot decompose and, after that, assemble together again without any loss. One of the reasons for this inability, perhaps essential by nature, is the partially irreversible and non-linear character of the evolutionary-developmental processes leading to their creation. Some differentiate, in reference to that, linear modular architectures from non-linear integral architectures (cf. BISHOP 2008, 229–48; BUNGE 2003, 7–35).

Linear interactions have an additive nature and lead to the creation of so-called *aggregative systems*. Such systems typically have a rather simple structure and their decomposition does not pose major difficulties. Elements of aggregative systems function based on their own, internal rules, which causes the systems to be *strongly modular*. Non-linear interactions, in turn, have a non-additive character and lead to the appearance of so-called *integral systems* in which the key role is played by non-linear feedback mechanisms that take place between particular organizational levels as well as between the system and its environment. As a result, integral systems have a much more complicated internal and external structure. A relatively simple example of an integral system is a cell, whereas very complex ones are represented by human brains and socio-cultural systems.⁹

Non-linear interactions within integral systems bind particular elements of the system with each other in a way that they cannot realize their functions outside of them. The decomposition of the integral system not only obliterates global processes, but also local ones realized by the particular subsystems. Elements of an integral system behave in a completely different manner in a system rather than beyond it, because their behavior is determined by the global organization as a whole. In such systems discerning the pre-existing elements from the whole that supervene them becomes problematic. In this case, the higher level of wholeness emerges from the elements and their functions in a distinct way. This is a phenomenon typical for all processes of self-organization which take advantage of a non-linear feedback mechanism. Non-linear dynamic systems are signified by a specific type of

⁹ The distinction between aggregative and integral systems was first introduced by the differentiation of aggregative from integral systems was introduced by Robert C. Bishop (BISHOP 2008, 230–31).

holism, which means that a non-linear structure cannot be created by simply adding its parts to each other.¹⁰

A priori, one cannot exclude the fact that the difference between aggregative and integral systems is a difference of degree, not of a particular type. This indicates the possibility of exchanging, at least, some of the modules in living organisms, including those participating in cognitive processes. Cognitive prosthetics have been used already for a long time, such as implants for organs of the senses: cochlear implants or artificial retinas. It is anticipated that in the next century, cognitive technologies will enter the domain of human biology, thus influencing the evolution of the *Homo sapiens* species. Artificial sensory organs will be created, and communicational devices implanted under one's skin as well as integrated computational systems aiding one's memory, perception, linguistic capabilities and emotional states.

The same refers to so-called cognitive feedback systems, where one of the elements is a living human being or animal, whereas some of the modules responsible for the realization of the cognitive functions are located outside of the skull¹¹. External modules belong to the exostructure of such a system. Prototypes of feedback driven cognitive systems are currently created within the framework of cognitive robotics as well as cognitive neurosurgery. The boundary between human beings and the cognitive tools and technologies that are used by them is becoming ever more fluid. New technologies are gradually becoming part of human cognitive systems. Consequently, it is hard to assess where the world ends and a particular individual starts (cf. CLARK 2008).

¹⁰ According to R.C. Bishop: "A linear system can be straightforwardly decomposed into and composed by subsystems. The composition of the system is then analogous to aggregating these parts ('the whole is the sum of its parts'). The linear behavior of the system in such cases is sometimes called *resultant* (as opposed to *emergent*). In nonlinear systems, by contrast, such a straightforward idea of composition fails. When the behaviors of the constituents of a system are highly coherent and correlated, the system cannot be treated even approximately as a collection of uncoupled individual parts ('the whole is *different* than the sum of its parts'). The principle of linear superposition fails and some particular global or nonlocal description is required taking into account that individual constituents cannot be fully characterized without reference to larger-scale structure of the system." (BISHOP 2008, 231).

¹¹ In case of the human being's cooperation with devices supporting natural processes we are dealing with so-called coupled systems. The realized cognitive processes coupled with them can undergo degradation as a result of damaging the external component, in the same way, in which the degradation of cognitive processes takes place as a result of the damage of the relevant component situated within the skull. External factors are equally important here as the internal components of the brain and the central nervous system. Cf. CLARK & CHALMERS 1998).

CONCLUSION: THE THEORY OF EMERGENCE
AS A PHILOSOPHICAL FOUNDATION
FOR COGNITIVE SCIENCE

The approach described above rejects the internalist concept of mental-cognitive systems. One of its extensions is so-called wide computationalism, a concept interpreting cognitive processes as processes of a computational nature, but as going beyond the endostructure of the cognitive system (which include some elements of the natural and the artificial environment). Traditionally, it was assumed that computational processes lying at the foundations of cognitive processes are situated exclusively within the boundaries delineated by the human skin or even skull. However, the very concept of the boundary of the cognitive system has rarely been the subject of systematic analyses.

Yet there are no good reasons to state that the human skin or skull constitute a magical barrier beyond which actual computational processes cease to be and are replaced by regular causal processes. According to Robert Wilson every cognitive system realizes its cognitive functions as an element of a broader informational system. If informational processes do not take place only in our brains, then the internalist theory of mind requires supplementation which will take into consideration an active role within the environment in the course of cognitive processes. So-called *active externalism* can without major difficulties accommodate the modular theory of mind, as long as the concept of the mental module is extended to particular elements belonging to the exostructure of the cognitive system (cf. WILSON 2004, 165).¹²

Michael Gazzaniga, one of the creators and most accomplished representatives of cognitive neuroscience, expresses the conviction that the theory of emergence constitutes one of the fundamental philosophical assumptions of contemporary science. In his opinion the phenomenon of emergence has been commonly accepted in physics, chemistry, biology, psychology, sociology, and even art. The idea of emergence points to the ability of physical objects to spontaneously self-organize into structures which begin to manifest properties that are not present on the level of the elements that compose

¹² A distinct case of a cognitive coupled system is a community of researchers carrying out tasks that are impossible to perform by individual researchers. In this case one can talk about a two-fold coupling: (a) between individual systems creating a collective cognitive system of a higher level and (b) between the collective cognitive system and its environment.

them. Examples of emergence may be traits and functions manifested by biological cells, ant colonies, shoals of fish or human brains. We deal with emergence when a new level of organizing matter occurs, and new structures (systems) as well as new laws and rules governing the behavior of these structures appear. According to Gazzaniga, consciousness, memory, thinking, morality and responsibility are examples of emergent functions and properties which emerge after crossing specific organizational thresholds of physical systems (cf. GAZZANIGA 2012).

Nowadays, a view that mental-cognitive processes emerge on the basis of self-organizing networks encompassing the brain, body and the environment, to various degrees, is beginning to dominate. The mind is not constituted exclusively by neuronal processes occurring within brains, but by a global network of conditions and dependencies (physical, chemical, biological, neuronal, socio-cultural), in which it is incorporated and on the basis of which it exists and develops. By examining the modular organization of the brain at the level of increasingly simpler computational operations we shall not discover many things about the mind. What is necessary is systemic and contextual research treating the brain as an integral component of the body, with the body itself treated as an integral component of its environment. The mind is rooted not only in the modular organization of the brain, it is also embodied and situated in a particular environment. On account of this, its holistic description and explanation must be interdisciplinary and multilevel. This, indeed, is the approach specific for contemporary cognitive science that constitutes one of the fields of applying the abstract (epistemological-ontological) concept of contextual emergence. The thesis that the theory of contextual emergence is the philosophical presupposition of contemporary cognitive science requires a separate detailed justification.¹³

¹³ Since this article is a synthetic overview, a presentation of a detailed argumentation for the thesis that the theory of contextual emergence constitutes the philosophical presupposition of cognitive science requires elaboration in separate texts. Cf. POZOBUT 2008, 79–97. An important theoretical context for contemporary discussions on the philosophical presuppositions of cognitive science is provided by the mechanistic model of scientific explanation. The proponents of this view make use of the concept of emergence that remains in close relation to the concept of contextual emergence. Cf. BECHTEL 2008.

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CONTEXTUAL EMERGENCE
AND ITS APPLICATIONS IN PHILOSOPHY OF MIND
AND COGNITIVE SCIENCE

Summary

The purpose of the article is to analyze the concept of contextual emergence as well as its selected applications in philosophy of mind and cognitive science. In the first section the author presents the general assumptions of the emergentist model of reality. He stresses that the concept of emergence can be applied to the description of various levels of organization of nature: one of these levels is that of mental-cognitive processes, analyzed within the fields of philosophy of mind and cognitive science. In the subsequent sections, he introduces the definitions of contextual emergence and systemic causation and he points to their selected applications to mental-cognitive systems. In the concluding part, he presents the ideas of Gerald Edelman and Michael Gazzaniga on the role of contextual explanations as well as the concepts of emergence in the philosophy of biology and cognitive neuroscience. He also indicates the possibility of incorporating the concept of contextual emergence into active externalism and the extended cognition theory.

EMERGENCJA KONTEKSTOWA
I JEJ ZASTOSOWANIA W FILOZOFII UMYSŁU
I KOGNITYWISTYCE

Streszczenie

Celem artykułu jest analiza pojęcia emergencji kontekstowej oraz jego wybranych zastosowań w filozofii umysłu i kognitywistyce. W pierwszej sekcji autor przedstawia ogólne założenia emergentystycznego obrazu rzeczywistości. Zwraca uwagę, że pojęcie emergencji ma zastosowanie do

opisu różnych poziomów rzeczywistości — jednym z nich jest poziom systemów umysłowo-poznawczych badany w filozofii umysłu i kognitywistyce. W kolejnych sekcjach wprowadza definicje emergencji kontekstowej oraz przyczynowości systemowej oraz wskazuje na zastosowania tych pojęć w odniesieniu do systemów umysłowo-poznawczych. W końcowej części artykułu, w nawiązaniu do prac Geralda Edelmana i Michaela Gazzanigi, omawia rolę wyjaśniania kontekstowego w biologii i neurokognitywistyce. Wskazuje również na możliwość wykorzystania pojęcia emergencji kontekstowej w analizie eksternalizmu aktywnego oraz teorii rozszerzonego poznania.

Key words: contextual emergence; philosophy of mind; cognitive science; contextual explanation.

Słowa kluczowe: emergencja kontekstowa; filozofia umysłu; kognitywistyka; wyjaśnianie kontekstowe.

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