Neoteny and the Playground of Pure Possibilities

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Abstract

Neoteny—the retention of juvenile traits in human adults, traits that characterize to some extent our juvenile or fetal evolutional ancestors—has been acknowledged, especially recently, as a decisive factor in human evolution. Such juvenile traits were insightfully understood by an eminent psychoanalyst, Donald Winnicott, in revealing how playing, for instance, plays a decisive role in the mental growth of children and, no less, in human coping with reality and in developing our culture, sciences, philosophy, and arts. From the viewpoint of a new philosophical approach—panenmentalism—I explicate what are the profound philosophical grounds for the great contributions of neoteny for us.

1. The Role of Neoteny in Human Evolution and Life

As the *Oxford English Dictionary* defines it, neoteny (from the German *Neotenie*) is "the retention of juvenile characteristics in a mature organism," especially "the appearance of ancestral juvenile characteristics in the adult stage of a descendant, as an evolutionary process in which somatic development is retarded."

Jules Bemporad ascribes the continual curiosity, playfulness, and plasticity of human adults to our neoteny, that is, to the "expansion of juvenile characteristics into adult life" (Bemporad 1991, p. 46). Following Stephen Jay Gould (1977),[1] Bemporad writes that we may be considered as slowly developing apes whose prolonged infancy allows us "to internalize and develop a much more complex behavioral and cognitive repertoire and who persist in displaying juvenile features well into adult life" (ibid.). Playfulness is striking among these juvenile features, and though playing is ascribable to all mammalian brains, as neuroscientist Jaac Panksepp mentions, humankind is still an especially playful species possibly because "we are neotenous creatures who benefit from a much longer childhood than other species" (Panksepp 1998, p. 287).[2]

[1] Gould's insight that "neoteny has been a (probably *the*) major determinant of human evolution" (Gould 1977, p. 9) has been strongly criticized by Shea (1989), McKinney and McNamara (1991), Godfrey and Sutherland (1996), and others. Nevertheless, the "case for neoteny" still gains strong support. See, for instance, Simel et al. 2009, p. 5743; Bufill, Agusti, and Blesa 2011, p. 729; McNulty 2012, p. 489; Zollikofer and De León (2013), p. 28; Hawkes 2014, pp. 33–34; and Cohen 2014.

[2] Furthermore, "play is an index of youthful health. … The period of childhood has been greatly extended in humans and other great apes compared with other mammals, perhaps via genetic regulatory influences that have promoted playful 'neoteny'" (Panksepp 1998, p. 298). Having discussed neoteny, psychologist David Bjorklund writes: "There is no other species that demonstrates curiosity and play into adulthood to the extent that *Homo sapiens* do. … Novelty and the unknown are typically avoided in adult animals, with the notable exception of humans. In fact, what academics do for a living is often termed as *playing* with ideas. Intellectual curiosity, or play, is a hallmark of the human species and likely a necessary component to invention" (Bjorklund 1997, p. 158). On the significance of human neoteny (defined as "the mechanism behind the epistemological plasticity of human cognition") for comparative epistemology, the cultural evolution of mind, and ethics, consider Shaner 1989, pp. 70– 90. Shaner fondly refers to the Buddhist maxim "Retain the child-like mind" (op.cit., p. 80).

Indeed, neoteny—the retention of juvenile traits in human adults, traits that characterize to some extent our juvenile or fetal evolutional ancestors—which could be shallowly and wrongly considered as a mere retardation,[3] has been acknowledged, especially recently, as a decisive factor in human evolution.[4] Hence, immunologist Irun R. Cohen has acclaimed neoteny as a major factor in making us human (Cohen 2014, §147: "Neoteny has made us human"). The saltatory evolution from the ancestral *Pan* (a chimpanzee-like primate) to the human relies upon neoteny, as "neoteny generated a leap in the developmental landscape from *Pan* to humans" (op. cit. §151). Cohen thus highlights the neotenal leap which inevitably characterizes our unique evolution as cultural beings. Human culture owes much to neoteny because

"Human culture has developed a new environment to solve the human's natural deficiencies. The ever-learning human brain in its collective communication has learned to pamper the fetus-like human body in the protective isolation of a life-long womb—the womb of human culture. The human survives, despite being an ever-immature chimp, by leaving the natural environment, for which it is so ill prepared, to construct a virtual womb … that it can inhabit till it dies. Human culture, like the womb that protects the developing fetus, provides housing, heating, air conditioning, ample processed food, and protection from the hazards of the natural environment, the environment to which the *Pan* progenitor was so well suited. The human has evolved as an unfit chimpanzee to build a new reality suited to its sorry physical specifications; the half-baked chimpanzee has cooked up a new world."[5] (op. cit. §148)

To create such a virtual womb or home, such an artificial environment without which we could not survive, we could not rely only upon our instincts or any ready-made, actual data;[6] we certainly needed quite different capacities—intellect, ingenuity or creativity, and, first of all, imagination. These capacities have enabled us to transcend the limitations and boundaries of our natural state, of our being animals, however highly developed. These uniquely human capacities rendered it possible for us to free ourselves from the bondage of instincts and actual data and to create a suitable environment, a womb-home, in which we could not only survive but also create science, art, literature, and philosophy, all of which are solely human creations. Hence, our debt to neoteny is even greater for we owe it not only our survival but also our human advantage and superiority. In a sense, our neoteny has rendered it possible for us to transcend our biological and genetic limitations. Though some of our genes are certainly involved in our neotenal being and capabilities, our neoteny has made it possible for us to transcend our genetic limitations. It has allowed our brain extraordinary and long-termed flexibility. As Irun Cohen puts it,

[3] Or, better, neoteny instructs us to look at this apparent "retardation" quite differently: "In many cases, important evolutionary changes are brought about by retardation of development, not by acceleration. This is reflected by the concept of *neoteny*, which means literally 'holding youth' or the retention of embryonic or juvenile characteristics by a retardation of development" (Bjorklund 1997, p. 155). Gould highlights "the undeniable role of retardation in human evolution" (Gould 1977, p. 9) and he considers human neoteny as an evolution by retardation (op. cit., p. 355).

[4] For innovating discussions of neoteny and human biological evolution and especially of neoteny and the human mind (also with regard to imagination, playing, and creativity, in reference to Newton, Darwin, and Einstein as examples), we are in debt to Ashley Montagu (1955, 1956, and 1989). As he concluded, "As persons we are designed to grow and develop our childlike behavioral traits through all the days of our lives, and not to grow up into fossilized adults" (Montagu 1999, p. 300). Furthermore, with the facts of neoteny, Montague may be on solid ground "in thinking of women as biologically more advanced than men," namely "of the female's natural biological superiority" (ibid.).

[5] Cohen's humorous and playful language here may remind one of the ideas of anthropologist Claude Levi-Strauss, who found that all human beings at any known time have done some cooking, which means that they have had to process their food according to recipes that have not been ready-made or naturally given but have had to be contrived by human imagination and ingenuity. This approach reminds very much of the Kantian idea that any given, empirical data has to adjust itself to the *a priori* forms of the Human Reason, otherwise we could not know empirical phenomena. All the more, according to Kant, our instincts, drives, and (passive) emotions should be subject to the moral imperative of our Reason. Thus, our morality is possible because we are not enslaved to our drives, (passive) emotions, and instincts but can liberate ourselves from them. That novel idea of Levi-Strauss can be easily associated with neoteny.

[6] Cf.: "Education is the proof of our relative freedom from instinctual determinism, and its power—either negative or positive—is based on what both John Dewey and contemporary neuroscientists call the 'original plasticity' of the young, which is a primary aspect of *neoteny*, or the extraordinarily long period of relative immaturity in humans" (Kennedy 2014, p. 103).

"Human brains manifest neotenic gene expression; the human brain does not complete the development of its networks till relatively late in life. It is interesting that this neotenic gene expression is not uniform, but characterizes specific parts of the brain, such as the prefrontal cortex—the areas we use to think conceptually and learn. The human brain manifests its plasticity—its ability to form new networks—far beyond the time limits of the brains of chimpanzees and other creatures. Brain maturation is marked by closure of the window of opportunity for making new networks; the mature brain stops developing; it just knows what it already knows. The delay in maturation affords the human brain with continuing flexibility and plasticity, and allows us to keep on learning throughout our lives. It is no accident that unusually creative brains often are associated with playful, ever-curious immature and playful personalities. Indeed, curious brains manufacture experience; we call it play. Playful curiosity is a mechanism by which brains organize their connections. Brains learn as they play. *Pans* and other mammals stop playing when they mature and close their brains; humans just never stop monkeying around. Play is the basis of creativity. Curiosity is not merely a strategy for solving problems; curiosity is fundamental to building brains." (op. cit., §147)

Thus, neoteny is associated with all our intellectual and artistic capabilities, such as conceptual thinking and learning, imagination, and creativity, not only in forming new networks but in any area in which we create something new. The flexibility and plasticity, owing to neoteny, keep the window of opportunities (better, of new possibilities) open for producing new networks in our brain. Neoteny keeps us always immature to some degree, which means that we cannot exhaust our creative and imaginative capabilities, as if we remain children all our lives. We should not relinquish our juvenile imagination if we want to make not only art but also philosophy and science. Hence, testifying about his way of thinking, Einstein said in a famous interview: "I am enough of an artist to rely upon my imagination. Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution" (Viereck 1929, p. 117). In this vein, when Einstein was asked by a librarian who was also a mother of young children, what kind of books he recommended them to read to cultivate their scientific talents, he advised her to let them read imaginative, fanciful works, as imagination is essential for doing science. Einstein was well known for the productive use of his imagination for revolutionary scientific discoveries by means of thought-experiments. Knowing, as natural scientists have known since Galileo had revealed that the Book of Nature must be written in mathematical language, that mathematics is the language in which nature reveals to us her secrets and wonders, Einstein could imagine or visualize how Maxwell's field equations would manifest themselves to a boy riding alongside a light beam (Isaacson 2007, p. 7). To watch the wonders of the world as if from the point of view of a child playing on the beach of a huge ocean was quite typical of an earlier genius of a scientist—Newton.[7] A fresh scientific look at natural phenomena, such as evolution, requires a lot of imagination and thus it also heavily relies upon our fortunate neoteny. What could be fresher than the viewpoint of a child?

Human saltatory evolution and human creativity and imagination are perfectly compatible. As Einstein put it, "Initially there is a great forward leap of the imagination" (as quoted by Isaacson 2007, p. 549). One cannot exaggerate the role of such leaps of the imagination in Einstein's innovations.[8] Leaps of imagination are inevitable to break out from the confines of conventional knowledge and wisdom. Such is the nature of our childlike ingenuity and imagination.

Yet what really does make such leaps possible not simply for the sake of entertainment and playing but also for the sake of actual scientific discoveries? After all, breaking out from the confines of conventional knowledge and wisdom may lead to fantasies that are not valid for actual reality and allegedly cannot serve the test of reality which natural science investigates. Why may the leaps of our imagination and playing not lead us astray from the truths about actual reality but, instead, reveal us the profound or hidden truths of nature? The answer to this intriguing question should wait till the third section of this paper.

[7] As Newton saw himself: "I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me" (Westfall 1980, p. 574).

[8] Cf.: "Einstein's visual imagination allowed him to make conceptual leaps that eluded more traditional thinkers" (Isaacson 2007, p. 93). Cf. op. cit., pp. 2, 4, 6, 7, 92, 360, 379, and 387.

2. Winnicott: Playing and Reality

Turning now to the insights of the eminent psychoanalyst, Donald Woods Winnicott, we can shed more light on Cohen's statement that "Play is the basis of creativity" (Cohen 2014, §147). Undoubtedly, we owe much of our understanding of the child's psychology and equally of the adult's one to the work of Winnicott. To understand his most significant contribution to the psychoanalytic insight concerning playing and actual reality, we should consider first his debt to Freud at that matter. According to Freud, the "transference playground" with its "almost complete freedom" (Freud, 1914, p. 154) is a typically mental creation, in which no current actual, external reality but inner, psychical reality is revealed. The playground—on which the freedom to conjure up the "unthinkable" or repressed possibilities and meanings prevails—is a fiction or an artifact, the mental phenomenon of transference, and is also "a piece of real experience" (ibid.). Freudian psychoanalytic therapy consists in replacing the analysand's neurosis by an artificial illness which is the transference-neurosis, and from which the analysand can be cured (ibid.). Transference "creates an intermediate region between illness and real [actual] life through which the transition from the one to the other is made" (ibid.), and it is of a provisional nature (ibid.). At this point, we are acquainted with the inspiration for one of Winnicott's most fruitful ideas.

Weaning the analysand from the illusions and fantasies involved in transference characterizes Winnicottian psychoanalysis, too. Like Freud, Winnicott thought that transference is a transitional phenomenon, and Winnicott's "intermediate area" is in the heart of our discussion at this section. This area is the third between inner, personal, subjective, psychical reality and the actual world in which the individual actually lives, and which can be objectively perceived (Winnicott, 1971, pp. 102–103; *cf*. 1975, p. 231). Inner and external reality are mingled or diffused in this intermediate area (or what he also calls "potential space"), so reality-testing must be suspended; it is the suspension of our testing of actual reality as it truly, objectively is. To this intermediate area belong transitional phenomena, such as transference and playing. As transitional, these phenomena are an inevitable phase in human growth and development. Nevertheless, as neoteny teaches us, such phenomena continue to remain with us as adults serving our creativity and imagination in art, religion, philosophy, imaginative living, projects, creative scientific work, that is, in scientific theories and discoveries (Winnicott 1975, pp. 241–242), and cultural experience in general (Winnicott 1971, p. 102). Regarding external, actual reality and reality-testing, the child, the analysand, the spectator, the artist, the scientist, or the philosopher must be eventually weaned from their fantasies or illusions at least to some extent. In other words, to be sane enough, we must eventually not forget the real distinction between inner and external, actual reality. For this reason, transitional, not objective, phenomena populate the intermediate area. Winnicott could not have denied that the ability to distinguish between inner-psychical and external-objective reality is a necessary condition for sanity: "Should an adult make claims on us for our acceptance of the objectivity of his subjective phenomena we discern or diagnose madness" (Winnicott 1975, p. 241). Being able to distinguish in this way is also a necessary condition for disillusionment (op. cit., pp. 238 and 240), for weaning (op. cit., p. 240), and for "objective perception based on reality-testing" (op. cit., p. 239). This is valid not only for psychotherapy and for the need to be weaned from the transference, but no less for scientific sanity as well as for our capability to enjoy works of art of any kind. Whenever we do not distinguish the reality of such work—such as literature, theatre, and cinema—from actual reality, we may lose our capability to enjoy them. Thus, no sane person is unable to distinguish between the intermediate area and external, actual reality, even when he or she, suspending reality-testing, does not actually make the distinction at that moment (in order, say, to enjoy a cinematic experience; but this enjoyment is involved with a suspension of the reality-testing not with abolishing it).

The analysands' ability to use the analyst depends on their "ability to place the analyst outside the area of subjective phenomena" (Winnicott 1971, p. 87). Similarly, Winnicott insists, "in examining usage there is no escape: the analyst must take into account the nature of the object, not as a projection, but as a thing in itself" (op. cit., p. 88). Indeed, "relating may be to a subjective object, but usage implies that the object is part of external reality" (op. cit., p. 94). Winnicott rightly emphasizes "the patient's attempt to place the analyst outside the area of omnipotent control, that is, out in the world" (op. cit., p. 91). This must be a difficult disillusionment which antecedently requires destruction of the object *in fantasy* (op. cit., p. 93), namely within the boundaries of the intermediate area (or "the potential space"). Winnicott concludes, "[i]n this way a world of shared reality is created which the subject can use and which can feed back other-than-me substance into the subject" (op. cit., p. 94). He defines the intermediate area as "a resting-place for the individual engaged in the perpetual human task of keeping inner and outer reality separate yet inter-related" (Winnicott 1975, p. 230). The ability to distinguish between inner and external reality must not contradict Winnicott's assumption that "the task of reality-acceptance is never completed, that no human being is

free from the strain of relating inner and outer reality" (op. cit., p. 240); or his assumption that the "matter of *illusion* is one which belongs inherently to human beings and which no individual finally solves for himself or herself" (ibid.). In Winnicott's view, we are doomed to everlasting wandering between illusions and disillusionment, and any disillusionment confronts us with external, actual reality. In this wandering, Winnicott's intermediate area, or "the potential space" (1971, p. 100), contributes much to further saving of open possibilities in art, science, various projects, in experiencing love and friendship, and in many other kinds of human creativity, including philosophy.

Playing like a child, our imagination entertains with new, fantastic ideas, and we can free ourselves from the bondage of actual reality as the received knowledge and understanding perceive it. Without such a freedom, no human evolution, no culture, no scientific progress, and no artistic creation could exist. Note that I am speaking about the bondage of actual reality as the received knowledge grasps it, not of this reality as such. No scientific progress could be achieved without relying upon data with which only actual reality and actual experience can provide us. Nevertheless, any confinement to the actual experience which we have had so far may block scientific progress; moreover, it may block any human progress which inescapably requires new projects, novel ideas, and new concepts which are not confined to the actual, empirical reality as our actual experience so far has made us acquainted with. Without intermediate areas for playing and entertaining with novel possibilities and new ideas, no human progress can be made. Instead, slavery and confinement to our so-far actual experience would alas prevail.

3. Panenmentalism, Saving Pure Possibilities, and Neoteny

Panenmentalism is a metaphysics which I originated and have elaborated on in various works.[9] This metaphysics concerns individual pure (mere, non-actual) possibilities which are mind-independent as well as entirely independent of any actuality and actual reality. Furthermore, this metaphysics treats those possibilities independently of any possible-worlds conception. Hence, panenmentalism refers to individual pure possibilities and not to any maximal realm of them (which is called "a possible world") or to the ways in which mere possibilities or actualities are represented in such a world.

Discussing the objects of our thought, philosophers may habitually prefer to refer to "abstract objects." Instead, a panenmentalist considers the objects of mere thought as individual pure possibilities which are specific or concrete enough. Regardless or independent of actual reality and of spatiotemporal and causal conditions, each individual possibility is pure (mere or non-actual). For instance, we can and may consider the table on which I have written this paper regardless of its spatiotemporal and causal conditions and of all the actual circumstances under which this table actually exists, and yet we can certainly identify this table, as an individual pure possibility of a table, which is different from any other pure possibility of another table. Our neotenal imagination is quite sufficient for considering the table in this way and to allow us access to its individual pure possibility. Without this pure possibility this table could not exist at all: not under its current actual conditions and circumstances and not under quite different actual conditions and circumstances. Without it, this table would lose its identity and turn to be simply nothing. Without it, this table would be ontologically, not only epistemologically, simply impossible.

A good example of individual pure possibilities is all the objects of pure mathematics, such as numbers and geometrical figures, all of which are mind-independent and also entirely independent of actual reality; they are discoverable and not inventible, as I will explain below.

Any actuality, any actual entity, is an actualization of an individual pure possibility. Any actualization must be physical, as the actual and the physical are subject to the same spatiotemporal and causal conditions. Hence an actuality is a physical realization of an individual pure possibility. This realization is subject to spatiotemporal and causal conditions and is possible only under actual circumstances. Each actuality is of its pure possibility alone, serving as the identity of this actuality, which means that multi-actualization of an individual pure possibility is excluded. Hence, only thanks to our access to individual pure possibilities can we distinguish between individual actualities and recognize any of them. Each individual actuality is identified and distinct from any other individual actuality on the grounds of the differences between their individual pure possibilities. No two pure possibilities can be identical otherwise they would be one and the same possibility instead of two. Indeed, as exempt of any spatiotemporal conditions, individual pure possibilities are subject to the law of the identity of the indiscernibles.

[9] See Gilead 1999; 2003; 2009; and 2011. For various applications of this theory, most of which are on natural sciences, consider Gilead 2004; 2005; 2008; 2010; 2013; 2014a; 2014b; 2014c; and 2014d.

To make scientific progress as well as scientific predictions, we have to exclude possibilities otherwise we could not have any truth about actual reality. To predict any phenomenon, we have to exclude some possibilities in advance. Left with as few possibilities as possible, we can examine actual data to base a reliable prediction on them. For instance, the question—Is HIV caused by a particular virus or by quite a different factor?—had to be treated on the basis that the number of the possibilities of the nature of that cause has been greatly reduced to make the required observations and experiments to realize what is the real, actual cause of HIV. On the other hand, if on the basis of our present state of science we exclude pure possibilities that eventually may be acknowledged as necessary to identify, know, and understand a particular actual phenomenon, this exclusion would block our scientific progress at least to the extent that this phenomenon is concerned. For instance, until 1982, in which Dan Shechtman observed the first quasicrystal under an electron microscope, the mere, pure possibility of such a "crystal" had been excluded on both theoretical-geometrical and empirical grounds. Only after the dogmatic exclusion of this possibility had definitely denied, did it become possible to make a revolutionary progress in crystallography (for details consult Gilead 2013). This is a classical case of a mistaken exclusion of pure possibilities (in this case, crystalline pure possibilities). In contrast, scientists have made most fruitful uses for physics in referring to mathematical pure possibilities, which were discovered entirely independently of actual observation or empirical experience, thanks only to fantastic mathematical imagination and a far-reaching reasoning. Non-Euclidean geometries had been discovered by means of mathematical imagination long before Einstein and other modern physicists made use of them in order to describe and understand in mathematical language major scientific phenomena. Another example is the mathematical symmetry SU(3), which had been discovered quite independently of empirical experience long before the discovery of the actual omega-minus and which made this discovery possible.

These are but a few examples of the indispensability of individual pure possibilities for scientific discoveries; there are many more of them. Note that I have mentioned the discovery of individual pure possibilities, not any invention of them (though, as I will mention below, we may invent some fictions—truthful fictions—as means for discovering some of these possibilities). The reason for this is that individual pure possibilities are mind-independent and hence discoverable and not inventible. A genuine artist can discover new individual pure possibilities that only he or she, as a singular person, can discover (which makes it a personal discovery, whose singularity is reflected in the irreplaceablility and induplicability of a genuine work of art), whereas scientific or mathematical discoveries can be made independently by several scientists or mathematicians simultaneously (for instance, the discovery of the infinitesimal calculus by Leibniz and Newton; the theoretical discovery of the omega-minus by Gell-Mann and Ne'eman; and the theoretical discovery of the Higgs boson by Robert Brout, François Englert, and Peter Higgs).[10] Thus mathematical or theoretical scientific discoveries are not personal discoveries, despite many actual cases in which such discoveries have first been made, in fact, by a single person only. Hence, in panenmentalist terms, "creation" is a personal discovery.

The objects of our mere thought, imagination, and creativity are individual pure possibilities. This implies that we are endowed with a non-empirical accessibility to these possibilities. The only way for us to have access to actualities is by means of empirical experience, observations, and experiments, whereas we have quite a different access to individual pure possibilities: we have such an access thanks to our imagination, ingenuity, and intellect which are not confined to actual reality and empirical data. We can imagine and reason beyond the boundaries of actual reality as we empirically know it at the moment. As in genuine arts and in pure mathematics, we can most specifically and concretely imagine possibilities of whose actual existence we have no evidence.

[10] Note that the 2004 Wolf Prize in physics was awarded to Robert Brout, François Englert, and Peter Higgs for their pioneering theoretical *discovery*, about eight years before the actual discovery of the Higgs boson in CERN. Furthermore, on 8 October 2013, the Royal Swedish Academy of Sciences announced its decision to award the Nobel Prize in Physics for 2013 to François Englert and Peter W. Higgs "for the *theoretical discovery* of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider" (italics added). Hence, in panenmentalist terms, Brout, Englert, and Higgs had independently and simultaneously discovered the *pure possibility* of the Higgs boson, which was discovered as an actuality in CERN. The antecedent discovery of that pure possibility made it possible to *predict* the *actual existence* of this particle.

Hence, we may contrive projects which—in comparison to actual reality—may be considered as mere fantasies or dreams and yet, having contrived them, we would turn to implement, realize, or actualize them in the actual circumstances under which we live. In this way, our dreams, fantasies, and imaginary or fabulous projects, all consisting of individual pure possibilities, would come actually true. But without contriving such possibilities, without discovering them beforehand, no such implementation could have become real. The same holds true for works of art. The ability of the artist to make personal discoveries of individual pure possibilities, of specific and concrete pure possibilities, is necessary for rendering these works actual.

We should enlarge instance such as this to include culture as a whole. Culture is not a gift of nature or ready-made; culture is human-made, an outcome of implementation of human projects consisting of pure possibilities, accessible to human imagination, ingenuity, and intellect which are not enslaved to actual reality and empirical experience. This human ability to transcend these reality and experience is the sign of our neoteny. It is in the nature of children to imagine and fantasize many things which are merely pure possibilities and not actualities; it is also in their nature not to accept anything actual as it is. They ask questions. They wonder why things, even the most usual and ordinary things, are the way they actually are. Actual facts rarely provide answers to their incessant questions. They do not consider actual reality and empirical experience as necessary but as contingent; for them, actual things could have been quite different. Human neoteny means that Winnicottian intermediate area (or "potential space") is most significant not only for children but equally, even more, for adults. Children, while immersed in playing in their potential space, frequently suspend reality-testing (actuality-testing, in panenmentalist terms). And so do we, while playing for our relief and pleasure and also while making mathematical, theoretical scientific, or artistic discoveries. Like children, adults need such a playground with pure possibilities. Neoteny is our actual, biological *capability* to have ever-open access to the realm of pure possibilities and to transcend the confinements of actual reality as we have actually known it so far. Panenmentalism replaces Winnicottian potential,[11] intermediate space with the realm of individual pure possibilities. These possibilities are the specific and concrete objects of our mere thought independent of actual reality.

Thought-experiments play a major role in scientific investigations and progress (again, Einstein's use of them is a good example). These experiments use only individual pure possibilities and the relations between them; otherwise, such experiments would not be called "thought-experiments" but rather experiments with actualities and observations concerning them. Our imagination, ingenuity, and intellect are the essential factors of constructing thought-experiments. Against the background of the above, thought-experiments, too, owe much to our human neoteny.

We know too little about the psychology and cognition of animals, first of all because we cannot communicate with them by means of any natural or artificial language. Animals, particularly mammals, undoubtedly have minds, are subject to some psychology, endowed with emotions, and the like. But we know nothing or almost nothing about their thoughts, whether or not they have human-like consciousness, imagination, or any access to individual pure possibilities. As I see it, we know for sure that we have such access but we are incapable, at least in the present state of science, to ascribe any such access to animals, however high they may be on the scale of evolution. So far, we are allowed to ascribe with certainty such access only to us, human beings. This access is our main superiority over any other existing creatures. This is the meaning and significance of our leap, our singular leap, in the history of evolution as a whole. To the best of my knowledge, we are the only creatures that transcend actual biological circumstances and have access to the province that is governed by our imagination, ingenuity, and intellect, to the realm of pure possibilities transcending actual reality and empirical experience.

Our accessibility to pure possibilities opens up actual reality and empirical experience for our knowledge and understanding. By means of our scientific theories, some of which are truthful fictions—fictions that serve us in discovering some actual truths (see Gilead 2009)—we have access to the deepest secrets hidden in actual reality, in nature.

[11] Panenmentalism replaces "potential" by "purely possible," as anything potential must depend on the actual which is antecedent to the potential and makes it possible (to use an Aristotelian example, the mature oak produces acorns which contain the potential of being mature oaks). In contrast, pure possibilities do not depend on anything actual. Panenmentalism thus treats Winnicottian potential space or intermediate area as a "room" enough for individual pure possibilities.

Scientists construct models, contrive theories, and make predictions, all of which consist of individual pure possibilities and the way they relate to each other (i.e. their relationality), to discover the laws of nature, the structures of matter, and the natural order in general. All these models, theories, and predictions are products of our playing with and entertaining ourselves with individual pure possibilities and their relationality.

Thanks to neoteny, children and adults alike are able to consider and imagine actual reality as contingent: for us, many actual things, events, and even actual history could have been different. Panenmentalism ascribes contingency to any actuality, facts, and events. In contrast, it ascribes necessity only to individual pure possibilities and their relationality. Thus, logical, mathematical, and many theoretical pure possibilities are subject to necessity, and the reason for that is that any individual pure possibility could not be different. As free from the bounds of spatiotemporal and causal conditions, each pure possibility is unchangeable, atemporal (or, if you like, eternal), indestructible, and was never born or created. The fate of any actuality is quite different—it was produced, created, or born, it is inescapably destructible, temporal, and transient. Thanks to our neoteny, to our actual accessibility to the realm of pure possibilities, we can liberate ourselves, at least in our imagination but certainly in advancing art, philosophy, science, and technology, from the bounds and confinements of actual reality and empirical experience. In this way, we transcend history and actual nature.

Moreover, thanks to our neotenal imagination we can strip any actuality[12] of all its spatiotemporal and causal conditions and of the actual circumstances under which it exists (reconsider the example of my table mentioned above). This leaves us with the identity, the pure possibility, of that actuality.

We can now have a concluding answer to the question that I raised at the end of the first section above: Why may the leaps of our imagination and playing with pure possibilities not lead us astray from the truths about actual reality but, instead, reveal us the profound or hidden truths of nature? Our access to the realm of pure possibilities inevitably serves us in identifying, knowing, and understanding actual reality as it truly is. The reason for this is that actualities, of which actual reality is made, can exist only as actualizations of individual pure possibilities. For instance, all physical entities are actualizations of mathematical-physical pure possibilities and their relationality, otherwise no modern natural science could be possible. In Galileo's terms, the Book of Nature is written in a mathematical language, which holds true for any progress that natural science has made since its very beginning as a modern science. Generally speaking, the indispensability of individual pure possibilities is not only logical (there is no actuality which is not logically purely possible) and epistemological (excluding some pure possibilities may result in ignoring their actualities and misidentifying them, as was in fact, for instance, the case of quasicrystals), but it is also ontological. Were pure possibilities nonexistents, actualities would have been nonexistents, too. Thanks to our epistemic accessibility to the realm of individual pure possibilities, we can recognize, identify, know, and understand actual phenomena as they truly are. In this way, the realm that is accessible to our imagination, ingenuity, and intellect and the realm of actual reality, accessible to our perception and empirical experience, are strongly connected, and our imagination, ingenuity, and intellect help us inevitably in testing actual reality and not only in our liberty from it. As long as we do not ignore the distinction between the realm of pure possibilities and that of actual reality, our imagination and independence of actualities are most useful for us and they should be considered as our great advantage.

Cohen rightly writes: "Curiosity is not merely a strategy for solving problems; curiosity is fundamental to building brains" (Cohen 2014, §147). In panenmentalist terms, the pure possibilities of curiosity are fundamental to actualizing our brains. Curiosity, playing, imagination, and creativity owe an inevitable debt to neoteny. A neotenal leap made possible the evolution of the human brain. Our brains actualize neotenal pure possibilities.

Neoteny is also our capability of imaging and knowing that actual things could have been different and that it is in our hands to create a future that will be different both from the past and the present. Moreover, it is in our capability to implement that, to render our fantasies and dreams actual. Thanks to our neoteny we can change nature, for better or for worse, in the image of the pure possibilities that are open to us.[13]

[12] Which is undeniably an actual possibility, for everything that actually exists is also actually possible.

[13] I am grateful to Professor Irun R. Cohen for letting me read the manuscript of his book and for allowing me to cite from it *in extenso*. This most enlightening text has introduced me to the wonders of neoteny.

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