CONSCIOUSNESS AND EVOLUTION

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Abstract. I analyse some of the key evolutionary issues that arise in the study of consciousness from a bio-philosophical point of view. They all seem to be related to the fact that phenomenality has a special status: it is a very complex feature, apparently more than biological, it is hard to define because of the plurality of its displays (cognition, various emotions, other complex functions such as vision) and it is difficult to study with classic evolutionary tools (such as philogenetics or paleoanthropology). Giving an answer to the question „is consciousness an adaptive trait?" thus seems to be very difficult and this paper intends to sketch some of the problems we should be concerned with when studying phenomenality as an adaptation.

The present paper is focused on the evolutionary aspects of consciousness regarded from a biological perspective. Metaphysically speaking, the approach is monistic. The article sketches some essential issues that ought to be taken into consideration when addressing complex issues such as phenomenality regarded as an adaptation.

The paper will consider three fundamental aspects of the problem:

1. the definition(s) of adaptation along with some essential aspects of this concept;

2. a demonstration of the way in which the criteria of adaptation can be applied to the phenomenon of consciousness, and

3. the methodological problem of the necessity of having a proper description of the concept as a basis for research.

What is adaptation?

Adaptation is a fundamental concept in the evolutionary discourse but, despite the fact that it is frequently used, there are controversies regarding the meaning of the term. There is, for example, a tendency to use it in the sense of a certain property of an organism (e.g. „the nose of the star-nosed mole represents an adaptation to particular ways of feeding in the harsh underground conditions") or a process with an observable result (e.g. „adaptation to the underwater ecosystem resulted, over time, in whales having a streamlined shape"). At the same time we can use the concept to refer to a single part of an organism, an individual as a whole, a population, or an entire species. We can also talk about adaptation in a strong or in a weak sense; the latter is synonymous with acclimatization (e.g. „people who live in areas with hot temperatures are more adapted to heat").

> 'Adaptation' is a word used in a variety of ways in biology. […] Since the process takes the same name from its outcome, it only generates confusion to refer to both the state and the process by the same term (Munson, Ronald, 1971).

Nevertheless:

> „Though explicit definitions are rarely given, there is ordinarily an agreement among evolutionists in case-by-case decisions about what traits are adaptive and whether or not a species is adapted."[1] (Munson, Ronald, 1971).

A commonsense use of the term can declare that adaptation is a property of an entity (structure, system, trait, function) whose possession favours the owner. Despite the plurality of definitions all of them assume the fact that adaptation is an *a posteriori* phenomenon: the mark of adaptation is not, by consequence, a given thing; it appears in time as a result of elimination and sexual selection. Collin Allen and Mark Bekoff (Bekoff, M., & Allen, C., 1995) contend that a certain feature of a system can be called an adaptation to perform a task *if and only if* the members of a population that possess it owe this fact to a selection process *and* that feature offers an advantage for performing that specific task.

Adaptation is not efficient in an optimum way. Some features whose functions imply, for example, high costs, are maintained unmodified for generations. There are always constraints that can restrict the phenotype from reaching a perfect adaptation:

[1] For a discussion concerning the anti-adaptationist views see Griffiths, E., P.,1996.

> [...] there are many alternative answers to the provocations of the environment and the dominant answer is dictated often by the structure of the organism itself. While the ancestors of the vertebrates and those of the artropodes had the advantage of the skeleton, the former had the conditions to develop an internal one and the latter, the conditions for an external one. The entire evolution of these two large groups has been influenced by the choice that was made at the level of the distant ancestors. It allowed vertebrates to develop into huge creatures like dinosaurs, elephants and whales, while the giant crab is the largest type that artropodes were able to attain. Taking into consideration the case of artropodes the necessity of the periodical moult of the external skeleton implied a formidable selective pressure against achieving big dimensions."[2] (Mayr, Ernst, 2004).

Adaptation is not synonymous with function. Ronald Munson (Munson, R., 1971) suggests that not all functions have an adaptive value and he offers the example of the irish elk: its impressive horns had the function of protecting against predators and attracting potential partners during mating season, at the same time. They did not, though, represent an adaptation because these weapons are the precise reason for the extinction of the irish elk. Thus it is not a contradiction to think that a certain feature has a specific function but does not also reflect an evolutionary process. That is why the reasoning that affirms that a trait of an organism has a specific function and the reasoning that says that the same trait is an adaptation do not always have the same truth value:

> [...] adaptational and functional sentences about the same trait ought to have the same truth-value in every case. That they do not is shown by the fact that „Heart-sounds in man are adaptive, for they permit the detection of heart dysfunction" may well be true whereas „The function of the heart is to produce heart-sounds" is patently false. Thus not all adaptations (i.e. adaptive traits) are functions. (Munson, R., 1971)

Furthermore, the criteria considered for defining a function are different from those that define an adaptation (Griffiths, E., P., 1996). There can be situations in which, through research, we can detect the function of a trait, but can never find out if it also has an adaptational value, or vice versa. Functions are not dependent on the environment in the way adaptations are (or functions that are also adaptations). At the same time there can be contexts in which, despite the fact that it is assumed that a feature represents an adaptation, we cannot know which aspect of the environment it is in response to. Furthermore, there can be many reasons to characterise something as

[2] The translation from Romanian by Irina Buda.

an adaptation. It can also serve several functions just as a singular function can be served by more than just one trait.

It is difficult to prove the presence of an adaptation, and we can say that the research methodology itself has some problems. The discussions concerning the possibility of discovering and proving it have been dominated, at least traditionally, by the abundant creation of adaptive scenarios:

> ... biologists may also use adaptive evolutionary scenarios to justify their adaptationist assumptions. (Mahner, M., Bunge, M., 1997)

> … adaptationists are justified in what Dennett calls their „blithe confidence" that, no matter how obscure the trait, an adaptive explanation will sooner or later be forthcoming.[…] evolutionary games and the like have created such a powerful engine for generating putative explanations that if we do not have several different potential adaptive explanations for each trait, we can assume that this is because we have not taken the trouble to generate them. Argument to the best explanations is impossible in this context, because there is more than one explanation which fits the data. (Griffiths, E., P., 1996)

Such scenarios represent the risk of speculation and can generate a critical reaction that considers this kind of approach as being non-empirical and not scientific[3]. Maybe this is the reason why the opposite is argued (Mayr, E., 2004), that it is almost impossible to demonstrate that there is a property of an organism that does *not have* a selective value (that is not an adaptation). We could however adopt a negative way of testing the authenticity of an adaptation: we can say it exists when all the attempts to prove the contrary have failed.

Functional generalisations represent another dilemma in the adaptationist program: if an organism appears, for example, in similar shapes in different species, it might be assumed that it has the same evolutionary basis. But a deeper analysis[4] can reveal something different:

> It has been suggested that the low birthweight characteristic of the genus *Ursa* is the result of an adaptive trade-off. It is the price bears pay for altering their physiology in order to allow hibernation. But a mapping of the two characters on to the relevant portion of the phylogenetic tree shows this cannot be the case. Low birthweight emerges before hibernation, and exists on branches on

[3] I find it pretty difficult, in these circumstances, to make, for example, a precise distinction between a function and an adaptation.

[4] The complexity of the evolutionary analysis is not one of the central aspects considered in this article, but it is relevant to underline that adaptive scenarios need to be sustained by rigorous scientific (philogenetic, environmental) research.

which hibernation never originated. Tests of this sort have wide application. (Griffiths, E., P., 1996)

These are only some of the elements an adaptationist theory should take into account when considering consciousness as a biological entity. But the problems grows when we focus on the specific traits of phenomenality.

Consciousness as adaptation

Evolutionism assumes the arbitrary way in which the biological traits appear and are transmitted. If a genetic mutation is favored at a phenotypic level and transmitted through several generations, this process is not the result of some kind of necessity[5]. The existence of an organ or of a function seems necessary just because it may prove its utility. But this is something contingent and there is no previous project to design it (e.g. there is no logical or metaphysical necessity in the fact that there are beings with interdigital membranes that are dependent on water). The illusion of design seems more obvious in the bigger picture: the variety of the trophic chains in ecosystems is not dominated by necessity, the carnivores do not exist to eat herbivores, just as herbivores haven't appeared in this world to be eaten by carnivores (although the common sense approach may leave the impression that this is a common intuition).

By consequence, no matter how familiar the feeling of possessing consciousness may be, we have to admit, from an evolutionary perspective, that this trait is a contingent fact, just like any other trait we have[6]. We shouldn't ask ourselves *why* it is *necessary* to be conscious; instead we can reformulate the question in terms like these: „What is the function (or the use) of consciousness?". And the question „what is the reason for consciousness as a process to exist?" can be replaced with: „what are the elements that determined the appearance of consciousness as a biological process?"

As previously mentioned, one of the key considerations in evolutionary research is the permanent correlation with the environment in which the species (or the individual) lives. We should also pay attention to the way in which the organ or the trait is related to the entire physical system. Moreover this is a step in recognizing an adaptation; it is plausible to consider an entity to be an adaptation if it contains information about it:

[5] We do not take into consideration, of course, the case of genetic manipulation.

[6] This observation is largely discussed by Th. Polger and O. Flanagan (Polger, Th., Flangan, O., 1997).

> Imagine trying to investigate the structure of the eye with only a vague understanding of optics. […] The eye contains tremendous amounts of information about light, and how to transform it to the organism's benefit. (Hagen, H., E., & Symons, D., 2007)

The embodiment by one system – the adaptation – of detailed information about useful transformations of another system – the target EEA– serves as a clear marker of natural selection. One of the most famous such examples is the Star of Bethlehem orchid whose nectar-producing organ lies 30 centimeters inside it. Darwin predicted than an insect with a proboscis at least 30 centimeters long would be discovered that pollinated the orchid. In 1903, 21 years after Darwin's death, a moth with a proboscis 25-30 centimeters in length was discovered that pollinated the orchid. It was christened *Xanthopan morgani praedicta*, in honor of Darwin's prediction.

Interpreting the information exhibited by adaptations about their EEAs[7] however, can be a formidable challenge. Without any backgroung facts, it will often be difficult, if not impossible, to correctly infer an adaptation's function. Darwin's prediction required considerable knowledge of plant pollination and the role of insects therein. Elucidating adaptations and their EEAs is an iterative process. Like keys and locks, the more that is known about one, the more that can be known about the other." (Hagen, E., H., Symons, D., 2007)

The essential issues that should be taken into account for an evolutionary-adaptive scenario are, according to Brandon (Polger, Th., Flangan, O., 1997) these five criteria:

1. we should focus on the evidence of selection (i.e. to see if it has occurred); then
2. we need an ecological explanation of the phenomenon of adaptation relative to the environment (i.e. the fact that a certain feature increases the adaptability of the entity that has it, relative to its ecological space). Another important step is examining if
3. the trait is heritable. There is, also, necessary information concerning
4. the structure of the population; we also need
5. philogenetic data about the origin of the feature (i.e. if an organ has evolved from others).

Regarding the evolutionary approach to the problem of consciousness as a biological trait, I would like to briefly consider these four issues which I consider to be essential:

[7] Environment of Evolutionary Adaptedness.

a. Which stimulus in the natural environment is this phenomenon related to (as a response)?
b. Is there any philogenetic information about its appearance?
c. Is consciousness heritable?
d. Do we have access to concrete, historical evidence of consciousness?

a.Which stimulus in the natural environment is this phenomenon related to (as a response)?

Eric Alden Smith (Smith, E., A., 2007) suggests that we can speak of three mental behaviours that are relevant from the point of view of evolutionary research. The first one is the semi-conscious or „relatively conscious", (e.g. the preference for facial symmetry). The second refers to deliberate decisions that involve a learning process but also interaction with other individuals (e.g. learning how to hunt[8]). The last, which is specific to humans, implies the existence of an intense intellectual life, with complex outputs (e.g. cultural, technological products). Conscious behavior encompasses the last two types; this means it presupposes several psychological manifestations with different degrees of complexity, some interconnected (e.g. the activity of writing), others taking place for a big part of our lives (e.g. visual consciousness), some involving a reflex action (e.g. walking) and others that are – excepting the idea that they are generated at the bio-chemical level of the brain – totally abstract (e.g. thoughts about Darwin's theory). Many of the behaviors that are conscious are shared with other species, like hearing or attention, and others are specific to humans, like metacognitive activity. It seems, then, that consciousness is a general term that subsumes different types of psychological actions. Some philosophers are scrupulous with these tinges – the adepts of mental realism, for example – others may choose to ignore them and take into consideration consciousness as a whole – like the partisans of reductionism.

Therefore it is plausible to think that a question with the following structure: „is consciousness a form of adaptation?" is naive or simplistic; it also generates difficulties for the research process because it involves an evasive notion, without explanatory power, whose content is ambiguous

[8] There is an question, in this case, to what extent this kind of activity is conscious from the viewpoint of animal subjectivity, or how much the animal consciousness differs from ours. It is possible to consider this a good Type II example when we take into consideration the animal activity of hunting, but to identifiy it with a Type III when we have in mind the similar human act.

and reference unclear. When we use the term „consciousness" what is the phenomenon we have in mind? Is it the state of being awake? Is it the ability to think or to feel? Is it the the metareflexive capacity to think about ourselves? Do we treat it as a harmoniously unified sum of states of mind or just as one psychological phenomenon? From a pragmatic viewpoint the study of consciousness would be easier if the concept were broken down into several different types of emotional and cognitive reactions, each of them being treated and studied with the adequate tools. Then, instead of asking „is consciousness a form of adaptation ?" there could be more specific questions, such as „is language an adaptation?", „what challenge in the natural environment represents the selective pressure that influenced the development of this trait?", „what feature has language evolved from?". I have chosen language as an example because it is a very important, specifically human ability, and it is also present in many of our conscious acts. But these kinds of questions can be asked for all the elements seen as parts of consciousness (e.g. different *qualia*, different types of memory).

Maybe such an approach can be useful for someone who focuses on an extended evolutionary study of consciousness. At the same time trying to investigate consciousness as a singular phenomenon from an evolutionary perspective seems futile because every psychological manifestation has different adaptational values (e.g. the role of the emotional phenomena seems to be different to that of the cognitive phenomena and they could have appeared in different circumstances).

What selective pressures are responsible for shaping a process like consciousness? Breaking down the concept can be useful: if it is reasonable to think, for example, about the utility of the visual *qualia*, of language or of having a sense of self, it seems, at the same time, improbable that the artistic *qualia* (at least some of them like melancholy, the feeling of the absurd,...) do actually have a positive role, a function, something that might have determined nature to transmit them. Flanagan (Nichols, S., & Grantham, T., 2000) suggests a way to reflect upon the utility of consciousness: „The inference to the best explanation is that conscious awareness of the environment facilitates semantic comprehension and adaptive motor control actions in creatures like us".

From a common sense viewpoint it is obvious that some aspects of consciousness are useful and others are not. Others do not even seem to respond to some external challenge: we can talk, for example, about artistic feelings that are good for us (e.g. they can bring relaxation, personal fulfilment) while others seem futile.

It may not be possible to give a complete answer to (a.), but I think that working with a partitioned concept of consciousness makes the research process more accessible.

b. Is there any philogenetic information about its appearance?

Intuitively it seems that the leap from any type of animal consciousness to human consciousness implies a gap that makes it impossible to find its philogenetic roots in our ancestors or other species. It is, again, not a question to which I can provide an answer, but I think this task can be undertaken with other more direct questions like: what is the origin of metareflexivity? What is the origin of the higher emotions?

An essential observation here is that one should never confuse the problems and questions concerning the evolution of the brain with those regarding the evolution of mind or consciousness. There are philogenetic data about the brain, but this does not necessarily mean that these data offer answers about the philogenetic past of consciousness. This imprecision, which is sometimes ignored, leads to the implicit identification of the cerebral processes with the conscious ones and this metaphysical equivalence leads the researcher to the impossible task of looking for answers concerning what is considered to be relevant and dilematic about the human mind (e.g. what is the use of pain, not the use of C-fiber excitation).

c. Is consciousness heritable?

In its complete form consciousness – as it can be observed or, better said, felt only at the adult stage of a normal person – is clearly not heritable. It seems to depend not just on our genetic potential as a species but on numerous external factors that appear in time, during the human developmental process. Therefore it represents the result of a complex process of individual growth, which is not transmitted, although the ability to evolve as a conscious individidual is.

If consciousness is not a heritable trait (being a far more complex process that seems to depend on many variables like social interaction, education, language acquisition etc.) what can we say, then, about the adaptive value of this phenomenon? This is, again, an intriguing question whose answer is hard to find (but this particularity of consciousness – not shared with other

biological traits or organs – should be kept in mind during an evolutionary study of this feature).

d. Do we have acces to concrete, historical evidence of consciousness?

Just as in the case of philogenetic evidence it should be mentioned that paleoanthropological evidence (e.g. fossils) is related to brain research, not to the search for traces of ancient phenomenality. There are no traces of phenomenal, conscious, states: there are no fossils of the sensation of red[9], or of the thoughts our ancestors had. It is possible, though, to look at indirect evidence like the behavioral traces that reflect the presence of a form of consciousness (e.g. the cave-paintings). One should never make the mistake of thinking of these kinds of cultural manifestations as representing historical evidence of consciousness. They are only evidence of what is usually associated with a conscious act, but sometimes this difference seems to be ignored.

There seems to be, though, an obvious difference between simple, primitive, artistic or religious manifestations, to which we have access, and traces of the presence of language in our primitive ancestors. Also indirect, evidence of the existence of language seems – intuitively – to be more convincing and more intimately related to the fact that a person from our evolutionary history shares the same feature of consciousness with us.

The discussion thus far has questioned the validity of the correlation between consciousness and adaptation; the last part of this article, however, will examine an alternative viewpoint which underlines the possibility that this phenomenon is the result of a process of natural selection.

The complexity argument

This type of argument has been presented in many ways and it underlines a controversial concept:

> The notion of 'complexity' has been understood in a variety of different and sometimes conflicting ways […]. To complicate matters further, „complexity" is intimately associated with several other contested terms, including „order",

[9] This argument that can be found in: Nichols, S., & Grantham, T., 2000.

„randomness", and „organization". [...] the search for a precise definition is worthwhile... (Nichols, S., & Grantham, T., 2000)

The complexity argument regarding consciousness tackles a problem that has been discussed in this article, namely the numerous capacities or phenomena that are considered to be implicit when the state of being conscious is approached. There are two fundamental reasons why it is reasonable to think that an organ or a function with a complex structure represents the result of an adaptation. First of all it is too improbable for an unselected, undirected, but complex variation to be transmitted over generations. Secondly the coordination of so many manifestations would be extremly difficult and, with no usefulness, it would deteriorate in time. It would also be too costly for the species to transmit it to later generations. This is why it is more plausible to consider it to be favoured by selective pressures.

Such an approach has been used to address an essential element of our human conscious architecture, namely language. Pinker and Bloom (Nichols, S., & Grantham, T., 2000) consider that the complexity of language represents evidence for the fact that it is an adaptation. Language implies numerous processes like lexical analysis, the recognition of phonemes or phonological analysis.

Despite the difficulties of defining consciousness (meaning even the identification and the accurate separation of all the processes that compose it), it appears to us to be a complex phenomenon. Nichols and Grantham discuss two aspects that entitle us to agree upon the complexity of consciousness: its unity and its ability to extract and work independently and simultaneously with multiple bits of information ("multiple input mechanisms"). The authors also present Brandon's considerations upon the relevance of knowing the use of a trait when we invoke the complexity argument: even though there are many traits whose utility has not yet been revealed, their complexity is a proof that suspends the possibility of their appearing and being maintained without a selective pressure.

There are organs which seem to more easily submit to the complexity argument because their function is also more obvious:

"The eye contains a number of parts including the cornea, iris, lens, muscles, and retina. Each of these parts is well-suited to playing some important role in the overall function of the organ: the cornea protects the eye, the iris controls the amount of light entering the eye, the lens focuses light on the retina, muscles allow for variable focus, different cells are sensitive to different wavelengths of light, etc. *Thus the eye is composed of a number of parts, each of which seems*

to contribute to the organ's ability to achieve the function of vision. „[10] (Nichols, S., & Grantham, T., 2000)

At the same time it is worth mentioning that giving up a complex structure can also represent an adaptative strategy. Simplicity which does not imply high costs is also a criterion for adaptive efficiency in the biological world.

Conclusion

In summary, this article has discussed two key issues. First, consciousness seems to have a special status when we are concerned with an evolutionary study. Its abstract, non-biological compounds make it difficult for it to respond to adaptive research in the way other complex traits do. Maybe we need a wider approach and some special instruments if we decide to try and investigate phenomenality as an adaptive feature.

A rigorous determination of the concept of consciousness is also needed. This necessity appears even more pressing in this case because we are dealing with a very complex phenomenon (or a group of phenomena); it seems to be an easier task to use the complexity argument in favour of an adaptation of an organ. The eye, for example, does not represent an abstract object and, despite, its complicated structure, we can obtain a perfectly reasonable description of it. But in the case of consciousness I consider a meticulous enumeration and definition of all the elements it encompasses to be fundamental. Its subjective, nontransparent and nonempirical characteristics problematize scientific research from an evolutionary perspective and also bio-philosophical positions concerning the status of consciousness as a result of a process of natural selection. Consequently, clarifying the concept of consciousness is an essential step in order to aid future research.

The aim of this paper is not, furthermore, to offer a definition of consciousness or to resolve all the questions concerning its adaptive state. Rather, it aims to outline some of the problems that arise in the process of studying this phenomenon from an evolutionary and philosophical perspective (I am not sure if these two ought to be considered separately when the case of phenomenality is involved) in order to apply the conclusions in a future reasearch program on this complex subject.

The philosophical approach focused on cognitive issues (consciousness, *qualia*, intentionality) should be more concerned with an explicit evolution-

[10] The italic emphasis belongs to me.

ary approach concerning these issues. I would recommend a detailed and interdisciplinary analysis of the ways in which the problem of consciousness responds to the evolutionary criteria (adaptation, natural selection, and not only these).

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